Geotechnical Engineering Report

W. J. B. Dorn VA Medical Center - Parking Garage
6439 Garners Ferry Road
Columbia, South Carolina

July 13, 2015
Terracon Project No. 73155038

Prepared for:
Guidon Design
Indianapolis, Indiana

Prepared by:
Terracon Consultants, Inc.
Columbia, South Carolina

July 13, 2015

Guidon Design
905 N. Capital Avenue, Suite 100
Indianapolis, Indiana 46204

Attn: Ms. Stacey Paul, PE

Re: Geotechnical Engineering Report
W. J. B. Dorn VA Medical Center - Parking Garage
Columbia, South Carolina
Terracon Project No. 73155038

Dear Ms. Paul:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with our Proposal No. P73150144 dated April 1, 2015 and authorized on June 24, 2015.

This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of foundations, retaining walls, and floor slabs for the proposed project.

We appreciate the opportunity to be of service to you on this project. Materials testing services are provided by Terracon. We would be pleased to discuss these services with you. If you have any questions concerning this report or we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

SOUTH CAROLINA LICENSED PROFESSIONAL ENGINEER No. 25833 KENNETH J. ZUR

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EXECUTIVE SUMMARY

A geotechnical investigation has been performed for a proposed parking garage to be constructed at W.J.B. Dorn VA Medical Center in Columbia, South Carolina. Nine (9) borings, designated B-1 through B-9, were performed to depths ranging from approximately 25 feet to 75 feet below the existing ground surface. Based on the information obtained from our subsurface exploration, the site can be developed for the proposed project. The following geotechnical considerations were identified:

- The subsurface soil conditions encountered within the footprint of the proposed parking garage generally consisted of up to 5-½ feet of undocumented fill followed by sandy silt/silty sand to silty/sandy clay that extended to depths ranging from 37 feet to 42 feet. The silts, sands and clays grade into a lean to fat clay that extends to the termination depth of the deepest Boring (B-2) at a depth of 75 feet.
- Groundwater was not recorded at the boring locations at the time of drilling due to the method of advancing the borings. When checked after a stabilization period (of 1 to 3 days), groundwater was not encountered to depths of 25 to 49 feet below the existing ground surface (cave-in depths).
- Based on the 2012 International Building Code and an average weighted shear wave velocity of 1,365 feet per second, the seismic site class for this site is “C”. Utilizing the mapped parameters from IBC 2012 and ASCE 7-10, a Seismic Design Category (SDC) of C was determined. A Site Specific Seismic Evaluation (SSSE) was performed which allowed the SDC to be modified from “C” to “B”.
- Based on the provided structural loads, subsurface soil conditions and using an allowable bearing capacity of 3,500 psf, total settlements for shallow spread footings are estimated to range from 1 to 1-½ inches with differential settlements approaching 50 percent of the total. To provide the noted bearing pressure and limit the total settlement to 1-½ inches, it will be necessary repair any soft foundation soils encountered at or near the bearing elevation of many foundations elements. Based on the boring data, we estimate about 45 percent of the foundations may require repair.
- Alternatively, shallow foundations can be supported on the existing soil column improved by stone columns. With their installation, shallow foundations can typically be designed with allowable contact pressures on the order of 5,000 to 7,000 psf without the need to repair the foundation soils.
- Close monitoring of the construction operations discussed herein will be critical in achieving the design foundation support. We therefore recommend that the Terracon be retained to monitor site and foundation construction for this project.

This summary should be used in conjunction with the entire report for design purposes. It should be recognized that details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of the report limitations.

GEOTECHNICAL ENGINEERING REPORT
W.J.B. DORN VA MEDICAL CENTER - PARKING GARAGE
COLUMBIA, SOUTH CAROLINA

Terracon Project No. 73155038
July 13, 2015

1.0 INTRODUCTION

This report presents the results of our geotechnical engineering services performed for the proposed parking garage to be located in Columbia, South Carolina. The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- earthwork
- seismic considerations
- retaining walls
- groundwater conditions
- foundation design and construction
- slab-on-grade design and construction
- other design considerations

Our geotechnical engineering scope of work for this project included the advancement of nine (9) soil test borings to depths ranging from approximately 25 to 75 feet below existing site grades. At three of the boring locations, in-situ pressuremeter testing was performed. In addition to soil borings, geophysical testing was performed to develop the shear wave velocity profile for the site.

Logs of the borings, shear wave velocity profile, the Site Location Map and the Boring Location Plan are included in Appendix A of this report. The results of the laboratory testing performed on select soil samples obtained from the site during the field exploration are included in Appendix B of this report. Descriptions of the field exploration and laboratory testing are included in their respective appendices.

2.0 PROJECT DESCRIPTION

2.1 Project Description

ITEM	DESCRIPTION
Site Location	Refer to the Site Location Plan (Exhibit A-1 in Appendix A).
Structure[2]	The garage will have three supported levels above the at-grade level. The garage will have a footprint of 124-feet by 318-½-feet.
Building construction[2]	The parking garage will be a pre-cast structure with bays on the order of 36 feet by 62 feet

ITEM	DESCRIPTION
Finished floor elevation[2]	The average finished floor elevation (FFE) is currently set at Elevation 249.8± feet MSL.
Structural loads[1]	Column loads: ■ 600 to 1,060 kips (ultimate) ■ 480 to 830 kips (service) Wall loads: ■ 34.4 to 36.2 kips/foot (ultimate) ■ 26.3 to 28.1 kips/foot (service) Slab-on-grade floor loads are expected to approach 100 psf.
Maximum allowable settlement[1]	Total: 1-½-inches Differential: ¾ inch between columns
Grading	Based on currently available information, we anticipate cuts and fills of up to 2 or 4 feet will be necessary to establish nominal construction grade.
Below grade areas	A 4- to 5-foot deep elevator pit is expected.

1. Based on information provided by Cal Walker, Inc.
2. Based on 35% structural and architectural design drawings.

2.2 Site Location and Description

ITEM	DESCRIPTION
Location	W.J.B. Dorn VA Medical Center is located at 6439 Garners Ferry Road in Columbia, South Carolina. The parking garage will be located in an existing parking lot located southwest of Building 106 (Mental Health – Dermatology).
Latitude and Longitude[1]	33.9752° N, 80.9620° W
Existing improvements	The majority of the site is currently an at-grade parking lot and loop road around the hospital campus. The remainder of the site consists of a landscaped berm that separates Byron Road from residential areas further to the west.
Current ground cover	Away from the noted berms, the footprint of the proposed parking garage is currently asphalt paved with landscaped medians.
Existing topography[2]	The construction area is relatively flat with surface elevations of 247 to 248 feet, except at the berm along Bryon Street which was generally 4 to 7 feet higher.
Site history	Based on a review of historical imagery (1939) of the area, it appears a portion of the area proposed for a new parking garage was occupied by a baseball diamond and associated structures. In a later dated image (1959), these structures had been removed.

ITEM	DESCRIPTION
1	Taken as the approximate center of the parking garage.
2	Survey information provided by Woolpert.

3.0 SUBSURFACE CONDITIONS

3.1 Geology

The site is located in the upper Coastal Plain physiographic province of South Carolina. The Coastal Plain is a wedge-shaped cross-section of water and wind deposited soil. Its thickness ranges from a featheredge at the surface contact of the Piedmont (Fall Line) to several thousand feet at the present day coastline. The sediments range in age from the Cretaceous and Tertiary periods at the contact with the bedrock to the recent period at the present coastline. The sediments include clays, silts, sands, and gravels, as well as organics.

Fill soils are those soils that have been placed or reworked in conjunction with past construction grading or farming. Fill can be composed of different soil types from various sources and can contain debris from building demolition, organics, topsoil, trash, etc. The engineering properties of the fill depend primarily on its composition, density, and moisture content.

3.2 Typical Subsurface Profile

Specific conditions encountered at each boring location are indicated on the individual boring logs included in Appendix A of this report. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in situ, the transition between materials may be gradual. Based on the results of the borings, subsurface conditions on the project site can be generalized as follows:

Description	Approximate Depth to Bottom of Stratum (feet)	Material Encountered	Consistency/Density
Surface	1-½ to 2-½ inches	Topsoil/Asphaltic Concrete	n/a
Stratum #1[1]	3 to 5-½	Fill - sandy clay	Stiff to hard
Stratum #2	37 to 42	Silty sand to sandy silt/clay	Medium dense/ soft to hard
Stratum #3	Termination depth of boring	Lean to fat clay	Very stiff to hard

1 Fill material encountered in Borings B-1, B-2, B-4, B-6, B-8, and B-9.

Laboratory tests were conducted on selected soil samples. The test results are included in Appendix B and presented graphically on the Boring Logs presented in Appendix A.

Additionally, testing specific to corrosion (pH, resistivity, etc.) was performed on select soils samples collected from Borings B-1 and B-6. The results of all analytical laboratory testing are also included in Appendix B.

3.3 In-Situ Pressuremeter Testing

In-situ testing was performed to better estimate the stress/strain behavior of the site soils utilizing the Roctest TEXAM Pressuremeter. A series of pressuremeter tests was performed at Borings B-3, B-5, and B-7 at depths ranging from 5 to 30 feet below the existing ground surface. The results of the pressuremeter testing are summarized in the following table. The results are also presented graphically in Appendix A. The pressuremeter testing for this project resulted in an E:N ratio (soil modulus to blow count) ranging from 4 to 10 with an overall average of approximately 8. Values of 4 or 6 are considered typical for most area soils in the absence of such site specific data.

Pressuremeter Test Results

Boring No.	Depth (ft)	E_P psi (ksf)	Depth (ft)	E_P psi (ksf)	Depth (ft)	E_P psi (ksf)
B-3	8	5,306 (764)	18	3,570 (514)	29	3,378 (486)
B-5	4	3,257 (469)				
B-7	8	3,961 (570)	16	1,821 (262)	30	2,634 (379)

3.4 Groundwater Conditions

Due to the method of drilling (i.e. mud rotary) groundwater readings at the time of drilling was not measured. When checked a minimum of 24 hours after drilling, groundwater was not encountered to depths of 25 to 49 feet. These observations represent groundwater conditions at the time of the field exploration, and may not be indicative of other times, or at other locations.

Groundwater level fluctuations occur due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the fieldwork was performed. Therefore, groundwater levels during construction or at other times in the life of the structure may be higher or lower than the levels discussed herein. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project. The groundwater surface should be checked prior to construction to assess its effect on grading activities and other construction activities.

4.0 GEOTECHNICAL SEISMIC EVALAUATION

4.1 Shear Wave Velocity Profile

Based on the results of the geophysical testing results (ReMi testing) performed for the W.J.B. Dorn VA Medical Center Parking Garage and considering the soil test boring data, the following average weighted shear wave velocity was utilized in our evaluation:

Test	Average Weighted Shear Wave Velocity ($\overline{V}s$)[1]
REMI Array	1,365 ft/s

1. Calculated in accordance with IBC 2012/ASCE 7-10

4.2 South Carolina Seismicity

Even though seismically active areas in the United States are generally considered to be in California and Western United States, historical records indicate that there have been major earthquake events in Central and Eastern United States (CEUS) that have not only been of equal or greater magnitude but that have occurred over broader areas of the CEUS. The United States Geologic Survey (USGS) indicates earthquakes that have caused damage within the United States between 1750 and 1996. Of particular interest to South Carolina is the 1886 earthquake in Charleston, South Carolina that has been estimated to have a Moment Magnitude (Mw) of at least 7.3.[1]

4.3 South Carolina Seismic Sources

The most severe earthquake to occur in South Carolina's recorded history occurred near Charleston in 1886. It was one of the largest earthquakes to affect the Eastern United States in historical times. The Mw of this earthquake has been estimated to range between 7.0 and 7.5. It is typically referred to have a Mw of 7.3. The faulting source that was responsible for the 1886 Charleston earthquake remains uncertain to this date.

Large magnitude earthquake events with the potential to occur in South Carolina are considered characteristic earthquakes. These earthquakes are modeled as a combination of fault sources and a seismic Area Source. The SC Seismic Hazard Study used the 1886 Earthquake fault source, also known as the Middleton Place seismic zone, and the "*Zone of River Anomalies*" (ZRA) fault source. For the 1886 Earthquake fault source, it assumed that rupture occurred on the NE trending "*Woodstock*" fault and on the NW trending "*Ashley River*" fault. The 1886 Earthquake fault source is modeled as three independent parallel faults.

[1] South Carolina Department of Transportation Geotechnical Design Manual 2010.

Recent studies (Marple and Talwani, 1993, 2000)[2] suggest that the "*Woodstock*" fault may be a part of a larger NE trending fault system that extends to North Carolina and possibly Virginia, referred to in the literature as the "*East Coast Fault System*". The ZRA fault source is the term used for the portion of the "*East Coast Fault System*" that is located within South Carolina. The ZRA fault system is modeled by a 145-mile long fault with a NE trend. The characteristic seismic Area Source is the same as is used in the 1996 National Seismic Hazard Maps. It models a network of individual faults no greater than 46 miles in length within the Lower Coastal Plain.

4.4 Seismic Evaluation

4.4.1 Site Specific Response Analysis

In order to model the seismic site response, a site specific response analysis has been conducted to define the Maximum Considered Earthquake (MCE) and Design Basis Earthquake (DBE) for a 2% probability of exceedance in 50 years (2500-year return period). The site specific response analysis was conducted in general accordance with Section 21.2 of ASCE 7-10.

4.4.2 Site Response Analysis and Computed Results

The site response analysis was conducted using the computer program EZ-FRISK commercially distributed by Risk Engineering. EZ-FRISK calculates the deterministic and probabilistic seismic hazard based on seismic sources and attenuation relationships. For the W.J.B Dorn VA Medical Center, the following seismic sources and attenuation relationships were considered:

<u>Seismic Sources</u>

- CEUS Gridded – AB
- CEUS Gridded – J
- New Madrid – Composite
- Charleston Composite
- Cheraw Fault

<u>Attenuation Relationships</u>

- Toro (1999) Midcontinent - USGS 2008 MbLg
- Frankel (1996) USGS 2008 Truncated MbLg - AB
- Campbell (2003) USGS 2008 MbLg - AB
- Atkinson-Boore (2006) ENA USGS 2008 - 140 Bar MbLg - AB
- Atkinson-Boore (2006) ENA USGS 2008 - 200 Bar MbLg - AB

[2] Marple, R.T., and P. Talwani, (2000), "Evidence for a buried fault system in the Coastal Plain of the Carolinas and Virginia; Implications for neotectonics in the southeastern United States", Geological Society of America Bulletin, v. 112, no. 2, pp. 200-220.

- Tavakoli-Pezeshk (2005) ENA USGS 2008 MbLg - AB
- Silva et al (2002) USGS 2008 MbLg - AB
- Frankel (1996) USGS 2008 Truncated MbLg - J
- Campbell (2003) USGS 2008 MbLg - J
- Atkinson-Boore (2006) ENA USGS 2008 - 140 Bar MbLg - J
- Atkinson-Boore (2006) ENA USGS 2008 - 200 Bar MbLg - J
- Tavakoli-Pezeshk (2005) ENA USGS 2008 MbLg - J
- Silva et al (2002) USGS 2008 MbLg - J
- Toro (1999) Midcontinent - USGS 2008 Mw
- Frankel (1996) USGS 2008
- Campbell (2003) USGS 2008 Mw
- Atkinson-Boore (2006) ENA USGS 2008 - 140 Bar Mw
- Atkinson-Boore (2006) ENA USGS 2008 - 200 Bar Mw
- Tavakoli-Pezeshk (2005) ENA USGS 2008 Mw
- Silva et al (2002) USGS 2008 Mw
- Somerville (2001) USGS 2008 Mw

The MCE for the 2500-year return period was determined in general accordance with ACSE 7-10 Sections 21.2.1, 21.2.1.1, and 21.2.2 for a 5% damped response spectra. The site specific design curve and parameters were created based on the procedures outlined in ASCE 7-10 Sections 21.4 and 21.5 and are included in following paragraphs.

The results of the site specific response analysis indicate that the seismic design values can be reduced to approximately 85 to 90 percent of the mapped design curve for a Site Class C. The site specific design values are provided in the table below. The site specific design curve is included with this report. Based on our analysis, the Seismic Design Category (SDC) for the parking garage can be modified from a “C” to a “B”.

Seismic Design Parameter	Value
S_{DS}	0.30 g
S_{D1}	0.13 g
PGA	0.16 g
T_o	0.04 sec
T_s	0.37 sec
SDC	B

5.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

5.1 Geotechnical Considerations

The boring data indicates that the native soil conditions encountered at the tested locations are generally compatible with the proposed construction. However, the following geotechnical considerations were identified during the course of this investigation that should be addressed during final design and construction:

- Undocumented fill
- Foundation considerations

Undocumented Fill: The majority of borings encountered undocumented fill to depths ranging up to 5-½ feet. The fill material is likely associated with past construction activities. Given the developed nature of the site, existing fill is likely to occur elsewhere within the footprint of the proposed parking garage. Based on the anticipated cut/fill requirements for this project, some of the existing fill will likely be removed during the course of general site grading activities (especially along the berm). The deeper fill areas will remain.

While there is no direct correlation between N-values and relative compaction, the recorded N-values from the soil borings indicate that portions of the existing fill may have received some compactive effort in its placement. Without construction documentation, there is an inherent risk for the owner that compressible fill or unsuitable material within or buried by the fill is present. The risk of unforeseen conditions cannot be eliminated without completely removing the existing fill material. Presuming that the owner can tolerate some risk, the first floor slabs can be supported on the existing fill, although subgrade repair will be necessary to provide a stable subgrade for fill placement and compaction.

To help manage the Owner's risk of allowing the fill to remain in-place for the slabs, Terracon recommends the existing fill be further evaluated. This should include performing hand auger borings with Dynamic Cone Penetrometer (DCP) tests to check the composition of the existing fill and field density testing to check its consistency and proofrolling of the existing subgrades. Depending on the findings, test pit excavation may also be necessary. It should be expected that undercutting and replacement of unsuitable fill soils may be required in some areas of the site to improve the subgrade support characteristics.

The existing fill soils (minus organics and other deleterious materials) is expected to be generally satisfactory for re-use as a structural fill. Dependent on the depth of excavation and the prevalent weather conditions at the time of construction, some moisture conditioning (i.e. wetting or drying) may be necessary to facilitate placement and compaction of this material to structural fill levels.

Although not directly encountered during the course of our field investigation, the potential exists to encounter remnants of past construction (i.e. the baseball diamond and associated facilities). As such, the construction budget should include a contingency to deal with these occurrences if and where they are encountered as well as any existing underground utilities and their backfill.

Foundation Considerations: Based on the results of the field testing and our engineering analysis, we estimate the total settlements associated with the anticipated structural loads on the order of 1 to 1-½ inches for the parking garage using an allowable bearing pressure of 3,500 psf. To realize the noted allowable bearing pressure, it will be necessary to replace some of the bearing soils to depths of up to 6 to 8 feet below existing grade to remove soft, settlement-prone materials. Based on the boring data, we estimate about 40 to 50 percent of the foundations may be affected.

Alternatively, the ground can be improved by the installation of stone columns to greatly limit the need for foundation subgrade repair. Stone columns have an added benefit as they can also increase the allowable bearing pressure of the foundation soils above what is typically available. Based on past experience with similar structures in the Columbia area, foundations supported on stone columns are typically designed with allowable bearing pressures ranging from 5,000 to 7,000 psf.

Geotechnical engineering recommendations for foundation systems and other earth-related phases of the project are outlined below. The recommendations contains in this report are based upon the results of field and laboratory testing presented in Appendices A and B, engineering analyses, and our current understanding of the proposed project.

5.2 Earthwork

The following presents recommendations for site preparation, excavation, subgrade preparation and placement of engineered fills on the project. The recommendations presented for design and construction of earth supported elements including foundations, retaining walls, and concrete slabs are contingent upon following the recommendation outlined in the following paragraphs. All grading for the structure should incorporate the limits of the proposed structure footprint plus a minimum distance of five feet beyond the construction limits.

Earthwork on the project should be observed and evaluated by Terracon personnel. The evaluation of earthwork should include observation and testing of engineered fill, subgrade preparation, foundations, and other geotechnical conditions exposed during the construction of the project.

5.2.1 Site Preparation

After the removal of the existing pavements, stone, topsoil, and/or remnants of previous construction and any other unsuitable materials should be stripped and removed from the construction area. The stripping should extend at least 5 feet beyond the construction limits. Clean topsoil (if any) may be stockpiled for reuse in landscaped areas. Once the contractor's stripping activities nears completion, we recommend that our representative observe the subgrade to identify any remaining pockets of organics or unsuitable material that should be removed.

Special precautions should be made to remove all existing underground utilities and their associated backfill as the new structure's foundations or concrete slabs/pavements may overlay these materials. Care should be given to locating and addressing these items during the site preparation phase of the project. If overlooked, they could be detrimental to the long-term performance of the building's concrete slab/pavement.

5.2.2 Subgrade Preparation

We recommend the exposed subgrades in at-grade areas, cut areas after overburden removal and in areas to be filled should be proofrolled to check for unstable soil conditions upon completion of stripping activities. Proofrolling is a very useful tool in identifying shallow areas of instability in the subgrade. Proofrolling should be performed after a suitable period of dry weather to avoid degrading an otherwise acceptable subgrade. Proofrolling will also aid in evaluating the undocumented existing fill identified within the footprint of the parking garage. The proofrolling load should be applied with a heavily loaded tandem-axle dump truck, scraper, or with similar approved construction equipment under the observation of the Terracon geotechnical engineer. Any areas that deflect or rut excessively and cannot be stabilized by further rolling should be undercut as recommended by the geotechnical engineer. If conditions are found to be unstable, the subgrade should be undercut to either allow the deeper soils to be reconditioned (densified in place) or to a depth that will provide a firm base for the compaction of the structural fill. The undercut soils should be replaced with compacted structural fill, placed as described in Section 5.2.4.

Positive drainage should be maintained at all times to prevent ponding of stormwater and direct surface runoff away from areas of active construction. This will prevent the weakening of prepared subgrade soils.

5.2.3 Material Types

Engineered fill should meet the following material property requirements:

Fill Type	USCS Classification	Acceptable Location for Placement
On-Site Borrow	SC, SM, and CL	All locations and elevations
Off-Site Borrow	SC and SM	All locations and elevations

Controlled, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation. Soils that classify as SC and SM should be utilized for ramp construction.

5.2.4 Compaction Requirements

ITEM	DESCRIPTION
Fill Lift Thickness	8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used. 4 inches in loose thickness when hand-guided equipment (i.e. jumping jack or plate compactor) is used.
Compaction Requirements [1,2]	95 percent of the material's standard Proctor maximum dry unit weight (ASTM D 698) and 98% within 12 inches of subgrade elevations for slabs and/or foundations.
Moisture Content	Within the range of -3 percent and +3 percent of the optimum moisture content as determined by the standard Proctor test at the time of placement and compaction.

1. We recommend that engineered fill be tested for moisture content and compaction during placement. Should the results of the in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the test should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

5.2.5 Temporary Excavations

It is recommended that all excavations on this site be performed in accordance with OSHA Excavation Regulations. For open cut excavation for utility lines, foundation construction, the elevator pit or as needed to stabilize subgrade soils, we recommend using the following backslopes for temporary cut slopes of 20 feet or less in height:

- Stiff to very stiff cohesive soil; 1H:1V (OSHA Type B Soils)
- Very soft to medium stiff cohesive soil; 1.5H:1V (OSHA Type C Soils)
- Granular soil; 1.5H:1V (OSHA Type C Soils)
- All existing fill; 1.5H:1V (OSHA Type C Soils)

Open cut excavations should not remain exposed to weather conditions for extended periods. Seepage or low strength conditions may dictate flatter slopes than those provided above.

The general soils conditions across the site indicate that OSHA Type C soils will likely be encountered during excavation of the elevator pit, foundations, and/or deep utilities. The excavations should be performed in accordance with OSHA Excavation Regulations based on the actual material encountered and field conditions at the time of the excavation. Compliance with OSHA Excavation requirements is the responsibility of the contractor's onsite "competent person" representative.

Deep utility installations and/or deep foundation undercuts at a minimum will likely require a large open excavation to maintain stability. The excavation should conform to OSHA standards for side slopes. If site constraints will not allow for a large open exaction (i.e. proximity to Building 106), the use of a shoring system will likely be necessary.

Construction site safety is the sole responsibility of the contractor who controls the means, methods and sequencing of construction operations. Under no circumstances shall the information provided herein be interpreted to mean that Terracon is assuming any responsibility for construction site safety or the contractor's activities; such responsibility shall neither be implied nor inferred.

The boring data indicate that the site soils should generally be excavatable using conventional construction equipment. Trenches and other shallow excavations can be performed using medium to large, rubber-tired backhoes. Large trackhoes will be necessary for the deeper excavations, such as for utility lines, generally due to the mass required to be moved.

5.2.6 Construction Considerations

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of first floor concrete slab(s). Construction traffic over the completed subgrade should be avoided to the extent practical. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted prior to floor slab and pavement construction.

The geotechnical engineer should be retained during the construction phase of the project to evaluate the existing fill, observe earthwork and to perform necessary tests and observations during subgrade preparation; proofrolling; placement and compaction of controlled compacted fills; backfilling of excavations into the completed subgrade, and just prior to construction of foundations and the first floor concrete slab/pavement.

5.3 Foundation Systems

5.3.1 Soil Supported Spread Footings

With proper site preparation and foundation repairs (i.e. undercut and replacement of soft foundation soils, when and where necessary), the proposed structure can be supported utilizing shallow spread footings bearing on in situ soils or compacted Controlled Fill. Design recommendations for shallow foundations for the structure proposed for this site are presented in the following paragraphs.

DESCRIPTION	Column	Wall
Net allowable bearing pressure [1]	3,500 psf	3,500 psf

DESCRIPTION	Column	Wall
Minimum dimensions	24 inches	18 inches
Minimum foundation bearing elevation [2]	244 feet	244 feet
Approximate total settlement [3]	<1-½ inches	<1-½ inches
Estimated differential settlement [3]	<¾ inch	<¾ inch
Equivalent unit weight for passive resistance [4]	300 pcf	
Coefficient of sliding friction [4]	0.35	

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation. Assumes any unsuitable fill or soft soils, if encountered, will be undercut and replaced with engineered fill.
2. Based on a FFE of 249.8± feet for load bearing foundation elements.
3. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of compacted fill, and the quality of the earthwork operations.
4. The sides of the excavation for the spread footing foundation must be nearly vertical and the concrete should be placed neat against these vertical faces for the passive earth pressure values to be valid.

We anticipate that the proposed parking garage may include non-load bearing curtain walls. This lightly loaded elements we expect that non-load bearing walls can be supported using shallow strip footings. Non-load bearing walls should be structurally independent of the primary load bearing elements of the parking garage. Design recommendations for a shallow foundation system are presented in the following table and paragraphs.

Description	Value
Net allowable bearing pressure [1]	2,000 psf
Minimum foundation embedment	24 inches
Minimum width for continuous wall footings	18 inches
Approximate total settlement [2]	Less than 1 inch
Estimated differential settlement [2]	Less than ½ inch
Equivalent unit weight for passive resistance [3]	300 pcf
Coefficient of sliding friction [3]	0.35

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation.
2. The foundation settlement will depend upon the variations within the subsurface soil profile, the structural loading conditions, the embedment depth of the footings, the thickness of compacted fill, and the quality of the earthwork operations.
3. The sides of the excavation for the spread footing foundation must be nearly vertical and the concrete should be placed neat against these vertical faces for the passive earth pressure values to be valid.

The soil mass providing uplift resistance for the foundations should be calculated as the zone contained within planes that extend up and out from the edges of the top of the foundation to the ground surface at an angle of approximately 30 degrees from the vertical. The ultimate uplift capacity should then be taken as the sum of the weight of soil in this zone plus the weight of the concrete foundation. An effective unit weight of 120 pcf for soil and 150 pcf for reinforced concrete could be used for calculations above the groundwater level.

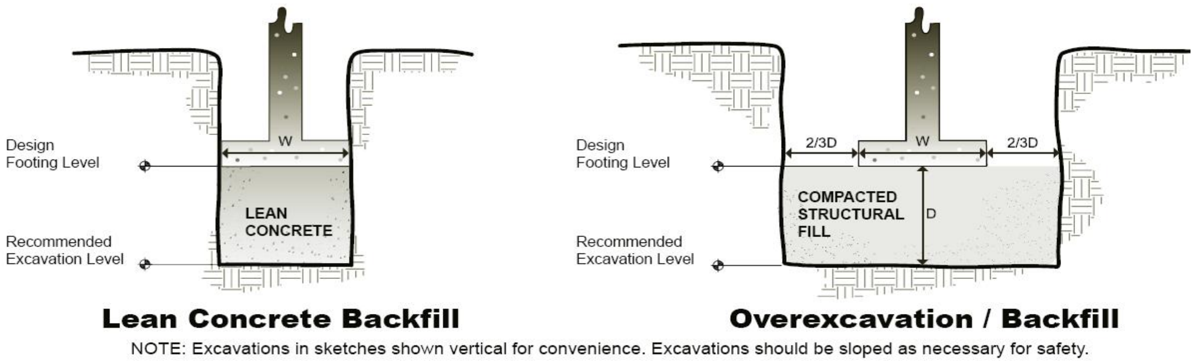
The allowable foundation bearing pressures apply to dead loads plus design live load conditions. The design bearing pressure may be increased by one-third when considering total loads that include wind or seismic conditions. The weight of the foundation concrete below grade may be neglected in dead load computations. Finished grade is the lowest adjacent grade for perimeter footings and floor level for interior footings.

Footings, foundations, and masonry walls should be reinforced as necessary to reduce the potential for distress caused by differential foundation movement. The use of joints at openings or other discontinuities in masonry walls is recommended.

5.3.2 Construction Recommendations

To check that soil bearing conditions compatible with the design values are achieved, we recommend that the footing excavations be observed and tested by a Terracon representative. This evaluation should include performing hand auger borings and dynamic cone penetration testing (DCP) at different locations and random probing of the foundation bearing surface.

If unsuitable bearing soils are encountered in footing excavations, the excavations should be extended deeper to suitable soils and the footings could bear directly on these soils at the lower level or on lean concrete backfill placed in the excavations. The footings could also bear on properly compacted backfill extending down to the suitable soils. Overexcavation for compacted backfill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of overexcavation depth below footing base elevation. Backfill material should be placed in lifts of 9 inches or less in loose thickness and compacted to at least 95 percent of the material's maximum standard effort maximum dry density (ASTM D 698). We anticipate approximately 40 to 50 percent of the load bearing foundation elements will likely require undercut and replacement to remove soft, settlement susceptible soils.



The base of all foundation excavations should be free of water and loose soil prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. If the soils at bearing level become excessively dry, disturbed or saturated, or frozen, the affected soil should be removed prior to placing concrete. Place a lean concrete mud-mat over the bearing soils if the excavations must remain open overnight or for an extended period of time. It is recommended that the geotechnical engineer be retained to observe and test the soil foundation bearing materials.

5.3.3 Shallow Foundations (Stone Columns)

The soil conditions at the site can be improved using stone columns (Geo-piers™ or vibro-piers™) to increase the allowable bearing pressure while limiting static settlements to within acceptable tolerances. The use of such soil modification techniques has allowed the use of allowable bearing pressures of 5,000 to 7,000 psf to proportion the footings for support of similar structures in the Columbia area. The actual value will depend on the number of stone columns per footing and the depth of penetration below the footing bottom as well as the required performance criteria. Such systems are proprietary and are typically designed by the specialty contractor in consultation with the structural engineer and the geotechnical consultant. Locally, these typically include Hayward Baker and Geopier Foundation Company. The stone columns are referred to as vibropiers and geopiers by those respective contractors.

The Geopier® system uses replacement Rammed Aggregate Pier (RAP) elements to reinforce good to poor soils. Geopier installation involves first drilling a large diameter hole, typically between 30 and 48 inches. Depending on design requirements, drill depths typically range up to about 40 feet. Layers of aggregate are then placed into the drilled hole in lifts of about one foot. A beveled tamper rams each layer of aggregate using vertical impact ramming energy. The tamper densifies aggregate vertically and forces aggregate laterally into cavity sidewalls. In general, vibro-piers are similar to geopier in general construction methods. The primary difference is associated with their compaction methods. The vibro-piers are compacted by the horizontal agitation of a vibrating probe rather than vertical compaction. This process continues as the probe incrementally rises from the bottom of the borehole. The diameters of the columns are somewhat variable, but a typical column would be about 3 feet.

In both cases, the process is generally performed on a grid pattern with several elements installed at specific locations (i.e. footings). Further, treated footprint is typically undercut and replaced with a zone of uniformly compacted soil or stone.

The installer of either system should provide detailed design calculations sealed by a professional engineer licensed in the State of South Carolina. The design calculations should demonstrate that the stone column-soil improved system is estimated to control long-term total and differential settlements to that required for the various foundations. The specialty contractor should warrant their work as well as the maximum total and differential settlements they predict. We recommend the design parameters be verified by a full-scale modulus test (similar to a pile load test) performed in the field. Terracon should be retained to monitor the modulus test and subsequent production installation.

The actual required depth and number of stone columns will depend on the foundation layout. It should be stipulated that the stone columns should be spaced to provide the noted allowable bearing pressure (as a minimum, actual bearing capacity may be significantly larger) while limiting the total settlement to within the range of the structural tolerance.

5.3.4 Foundation Considerations

In the event that ground improved with stone columns is selected for this project, we recommend that the owner budget for a comprehensive precondition survey of surroundings structures be made prior to commencement of ground improvement to provide a baseline of existing building conditions. Terracon can provide these services, including installation of the survey monuments, inclinometers, and precondition photo documentation, as needed to document the existing conditions and monitor the construction vibrations. We recommend the AASHTO R8-96 criteria (a customary used criteria governing construction related vibrations) be utilized for this project.

Based on the current site layout, we do not anticipate foundation loads from the new parking garage (either traditional spread footings or foundations supported on stone columns) will adversely impact the foundation system (or underlying soils) of the existing structure (Building 106 – Mental Health and Dermatology). As such, the need to permanently underpin or shore Building 106 is not anticipated at this time although depending on the depth of excavations temporary ground support may be necessary during construction may be necessary. If the building orientation and/or relative location of the parking garage to the existing structure are modified, Terracon should be notified to review and revise our recommendations accordingly.

5.4 Floor Slabs

5.4.1 Design Recommendations

DESCRIPTION	VALUE
Interior building floor system	Slab-on-grade concrete.
Modulus of Subgrade Reaction	125 pounds per square inch per in (psi/in)

DESCRIPTION	VALUE
Floor slab support	Minimum 12 inches of approved on-site or imported soils placed and compacted in accordance with Earthwork section of this report.
Subbase	4-inch compacted layer of free draining, granular material including fine to coarse sand.

Where appropriate, saw-cut control joints should be placed in the slab to help control the location and extent of cracking. Design and construction of the concrete slab should follow the recommendations presented in the American Concrete Institute (ACI) Design Manual (ACI 302.1R, 318-08, and 360R) for the anticipated loading conditions. The floor slab subgrade should be prepared as discussed in Section 5.2.4.

To minimize the effects of differential settlements across the slabs and to reduce the affects of repeated transient loading from vehicle traffic, the interior joints should be dowelled following recommendations by ACI. In general, the concrete slabs should be designed utilizing the requirements as recommended by ACI for the anticipated structural application.

Slab construction can begin after the completion of any fill placement necessary to establish nominal construction grades. We recommend that floor slabs be designed as "floating" slabs, that is, fully ground supported and structurally independent of any foundation elements. This is to aid in minimizing the possibility of cracking and displacement of the floor slabs because of differential movements between the slab and the foundation. Positive separations and/or isolation joints should be provided between slabs and all foundations, columns or utility lines to allow independent movement. Interior trench backfill placed beneath slabs should be compacted in accordance with recommendations outlined in the Earthwork section of this report.

5.4.2 Construction Considerations

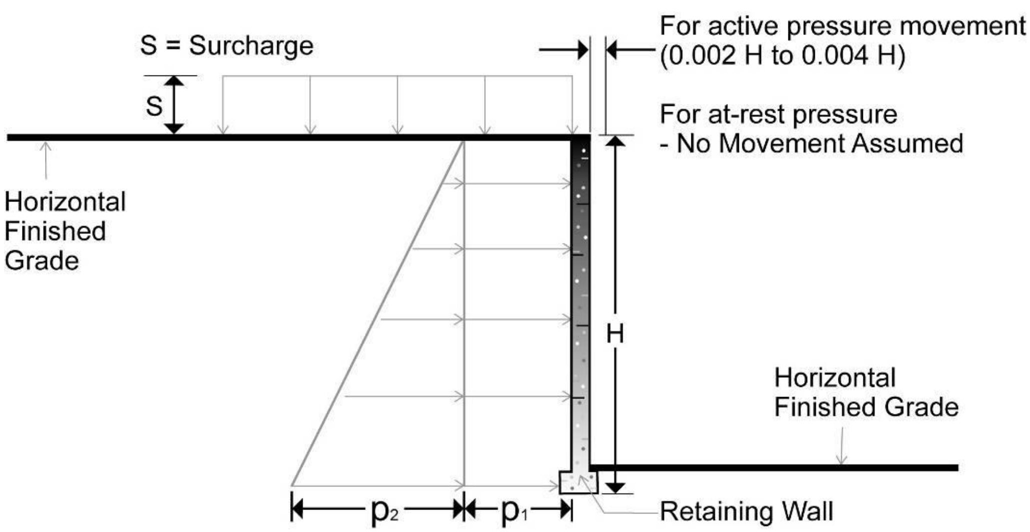
We recommend the area underlying the floor slab be rough graded and then thoroughly proofrolled with a loaded tandem axle dump truck prior to final grading and placement of base rock. Particular attention should be paid to high traffic areas that were rutted and disturbed earlier and to areas where backfilled trenches are located. Areas where unsuitable conditions are located (including any existing undocumented fill) should be repaired by removing and replacing the affected material with properly compacted fill. All floor slab subgrade areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to placement of the base rock and concrete.

On most project sites, the site grading is generally accomplished early in the construction phase. However as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. As a result, the floor slab subgrade may not be suitable for placement of base rock and concrete and corrective action will be required to repair the damaged areas.

5.5 Lateral Earth Pressures

Reinforced concrete walls with unbalanced backfill levels on opposite sides should be designed for earth pressures at least equal to those indicated in the following table. Earth pressures will be influenced by structural design of the walls, conditions of wall restraint, methods of construction and/or compaction and the strength of the materials being restrained. Two wall restraint conditions are shown. Active earth pressure is commonly used for design of free standing cantilever retaining walls and assumes wall movement. The "at rest" condition assumes no wall movement. The recommended design lateral earth pressures do not include a factor of safety and do not provide for possible hydrostatic pressure on the walls.

These design parameters should not be used in the design of mechanically stabilized modular block retaining walls (MSE walls). Additional analyses and design parameters for these retaining walls can be provided upon request.



Earth Pressure Coefficients

Earth Pressure Conditions	Coefficient for Backfill Type	Equivalent Fluid Density (pcf)	Surcharge Pressure, p_1 (psf)	Earth Pressure, p_2 (psf)
Active (K_a)	Off-site sand - 0.33	40	(0.33)S	(40)H
At-Rest (K_o)	Off-site sand - 0.50	55	(0.50)S	(55)H
Passive (K_p)	Off-site sand - 3.0	300	---	---

Applicable conditions to the above include:

- For active earth pressure, wall must rotate about base, with top lateral movements of about 0.002 H to 0.004 H, where H is wall height.
- For passive earth pressure to develop, wall must move horizontally to mobilize resistance.
- Uniform surcharge, where S is surcharge pressure.
- In-situ soil backfill weight a maximum of 115 pcf.
- Horizontal backfill, compacted between 95 to 98 percent of standard Proctor maximum dry density.
- Loading from heavy compaction equipment not included.
- No hydrostatic pressures acting on wall.
- No dynamic loading.
- Safety factor of 1 included in soil parameters.
- Ignore passive pressure in frost zone.

Backfill placed against structures should consist of granular soils such as those present at the site. To calculate the resistance to sliding, a value of 0.35 should be used as the ultimate coefficient of friction between the footing(s) and the underlying soil.

To control hydrostatic pressure behind the ramp walls and allow the use of drained parameters, we recommend that a drain be installed at the base of foundation walls with a collection pipe leading to a reliable discharge. The drain should interconnect with a prefabricated drainage media or a zone of freely draining aggregate, such as #57 stone, behind the vertical face of the wall. A filter fabric should separate the aggregate from the soil backfill to limit the migration of fines. Filter fabric should also cover the weep holes to limit the loss of drainage media through the hole.

If this is not possible, then combined hydrostatic and lateral earth pressures should be calculated for granular backfill, an equivalent fluid weighing 85 and 95 pcf should be used for active and at-rest, respectively. These pressures do not include the influence of surcharge, equipment or vehicle floor loading, which should be added. Heavy equipment should not operate within a distance closer than the exposed height of the walls to prevent lateral pressures more than those provided.

5.6 Soil Corrosion Considerations

Laboratory pH, chloride, and sulfate content tests were conducted at an analytical lab on two selected soil samples recovered from Borings B-1 and B-6 to assess the corrosivity risk of the soils. The results of the analytical testing are provided in Appendix B of this report. If any buried concrete will be used on this project, the following corrosivity information should be considered.

Based on our laboratory pH testing, the soil tested has a pH between 7.66 to 8.07. The pH of the samples fall at the upper end of the recommended range and indicates that the soil pH may provide a minor contribution to corrosion potential. Data suggests that the soil pH should not be a dominant soil variable affecting soil corrosion if the soil pH is in the range of 5 to 8.

The sulfate test results indicate the water soluble sulfate concentration at Borings B-1 and B-6 was below 0.01% by weight. According to Section 1904.3 of the 2012 International Building Code, concrete that will be exposed to sulfate-containing solutions should be designed in accordance with ACI 318, Section 4.2 in which an exposure class of S0 is anticipated. As such, there is no restriction on cement type that can be utilized for the construction of below grade concrete elements associated within this project. Chloride test results indicate the water soluble chloride concentration at the test locations fell below detection limits.

6.0 GENERAL COMMENTS

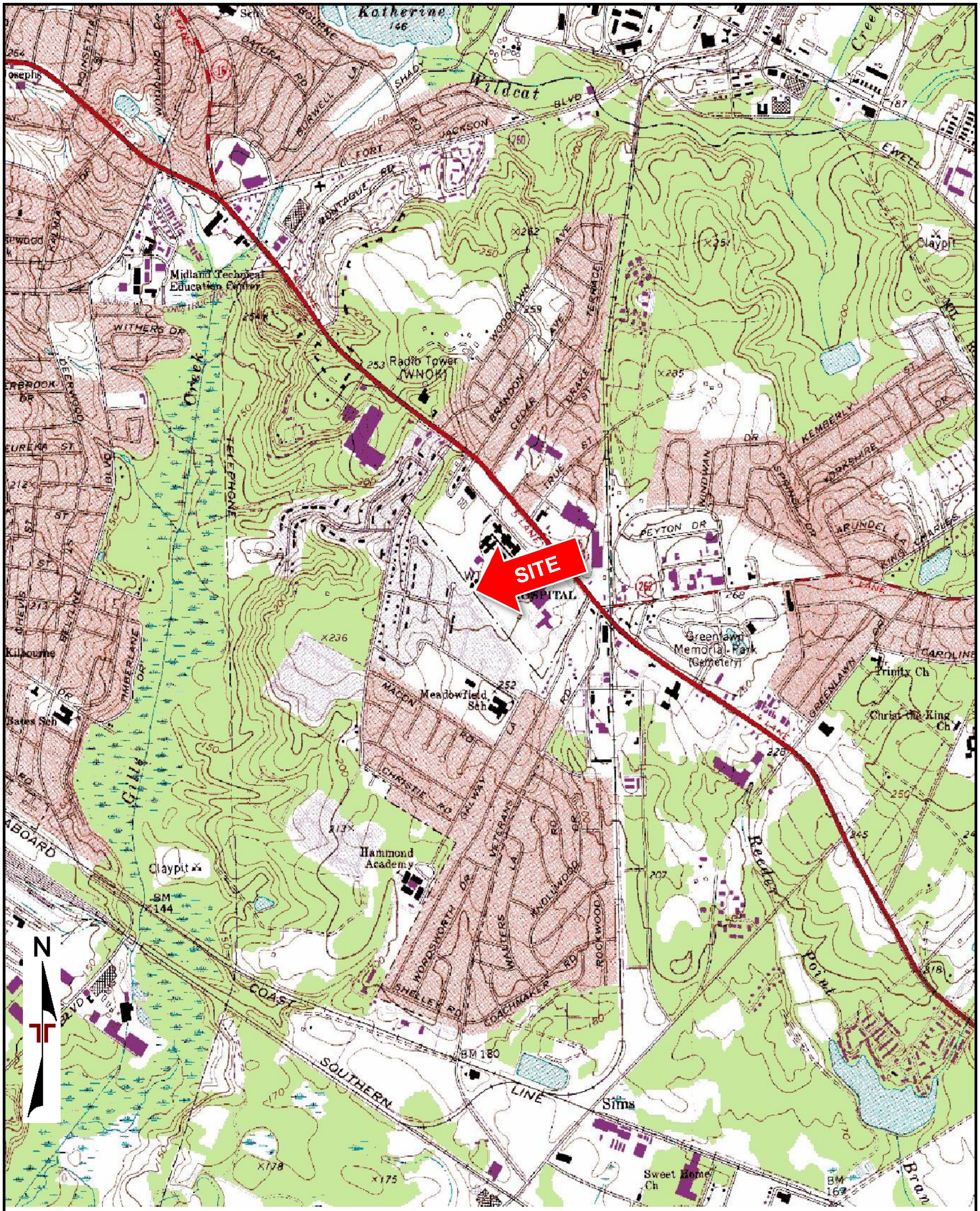
Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide testing and observation during excavation, grading, foundation and construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A
FIELD EXPLORATION



TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY
QUADRANGLES INCLUDE: FORT JACKSON SOUTH, SC (1/1/1987).

Project Manager: KJZ	Project No. 73155038	Terracon	SITE LOCATION MAP	Exhibit
Drawn by: PTK	Scale: 1"=24,000 SF	521 Clemson Road	**W.J.B. Dorn VA Medical Center Parking Garage**	A-1
Checked by: KJZ	File Name: 73155038	Columbia, SC 29229	**6439 Garners Ferry Road**	
Approved by: PAM	Date: July 2015		**Columbia, South Carolina**	

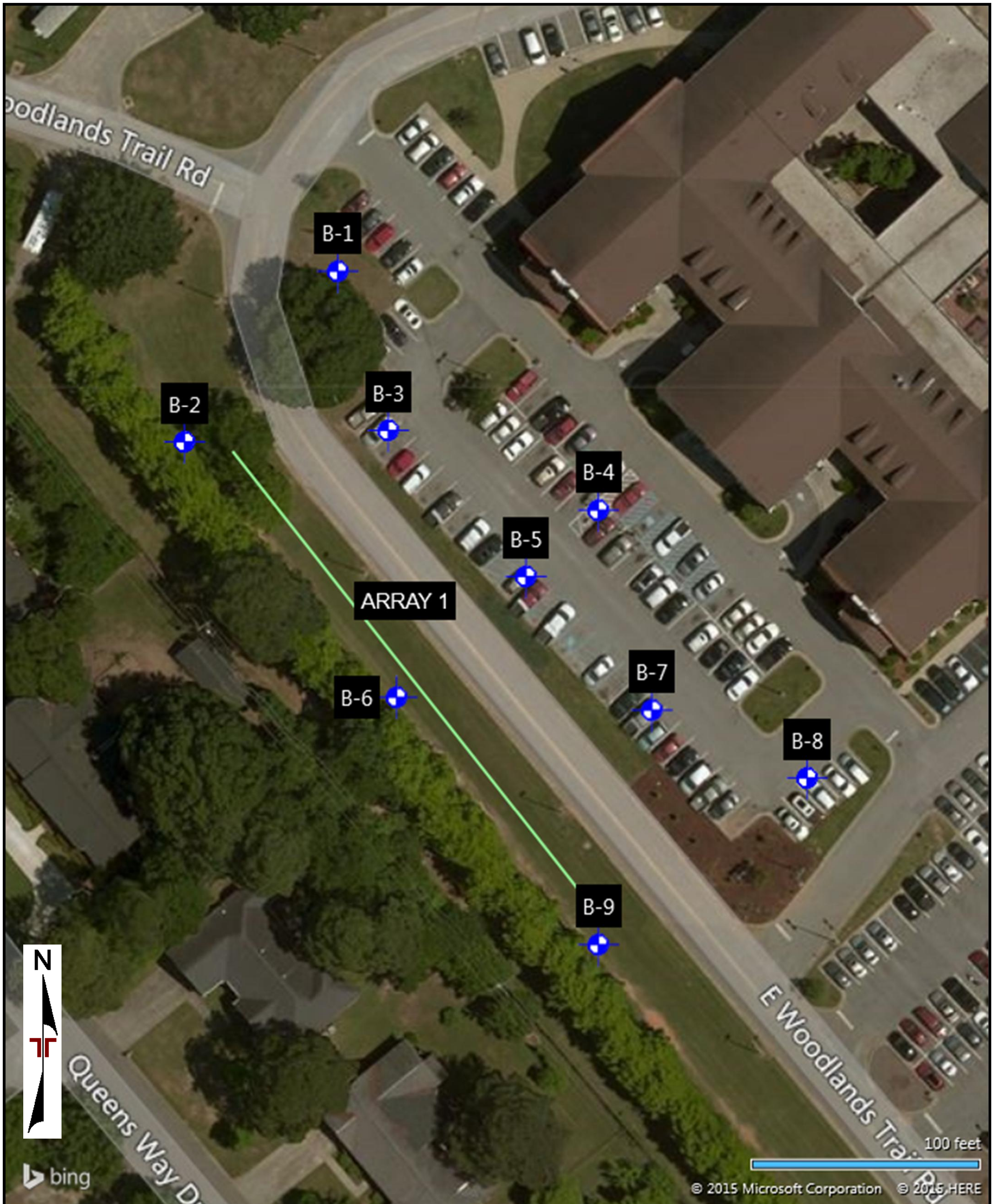


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

AERIAL PHOTOGRAPHY PROVIDED BY MICROSOFT BING MAPS

Project Manager: KJZ	Project No. 73155038	Terracon 521 Clemson Road Columbia, SC 29229	EXPLORATION PLAN	Exhibit
Drawn by: PTK	Scale: AS SHOWN		W.J.B. Dorn VA Medical Center Parking Garage 6439 Garners Ferry Road Columbia, South Carolina	A-2
Checked by: KJZ	File Name: 73155038			
Approved by: PAM	Date: July 2015			

Field Exploration Description

Nine (9) test borings were drilled at the site from May 22, 2015 through June 3, 2015. The borings were drilled to depths ranging from approximately 25 to 75 feet below the ground surface at the locations shown on the Boring Location Plan, Exhibit A-2.

The borings were located in the field by using the proposed site plan and an aerial photograph of the site, and measuring from local landmarks. Further, the state plane coordinates and surface elevations of each of the boring locations was surveyed by personnel of Woolpert and provided to our office on May 29, 2015. The boring locations shown on the Boring Location Plan (and elevations on the boring logs) should be considered accurate to the degree of survey.

The test borings were advanced with an ATV-mounted CME-550 and a truck-mounted CME-45C drill rigs utilizing mud rotary drilling techniques. Continuous lithologic logs of each boring were recorded by our field personnel during the drilling operations. At selected intervals, samples of the subsurface materials were taken by driving split-spoon samplers.

A CME automatic SPT hammer was used to advance the split-barrel sampler in the borings performed on this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT values and soil properties are based on the lower efficiency cathead and rope method. This higher efficiency affects the standard penetration resistance blow count (N) value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

Representative disturbed soil samples were obtained from the borings and were placed in sealed containers and returned to our laboratory where our engineer visually reviewed and classified them. The purposes of this review were to check the drillers' field classifications and visually estimate the soils' relative constituents (sand, clay, etc.). The soil types and penetrometer values are shown on the Boring Logs. These records represent our interpretation of the field conditions based on the driller's field logs and our engineer's review of the soil samples. The lines designating the interfaces between various strata represent approximate boundaries only, as transitions between materials may be gradual.

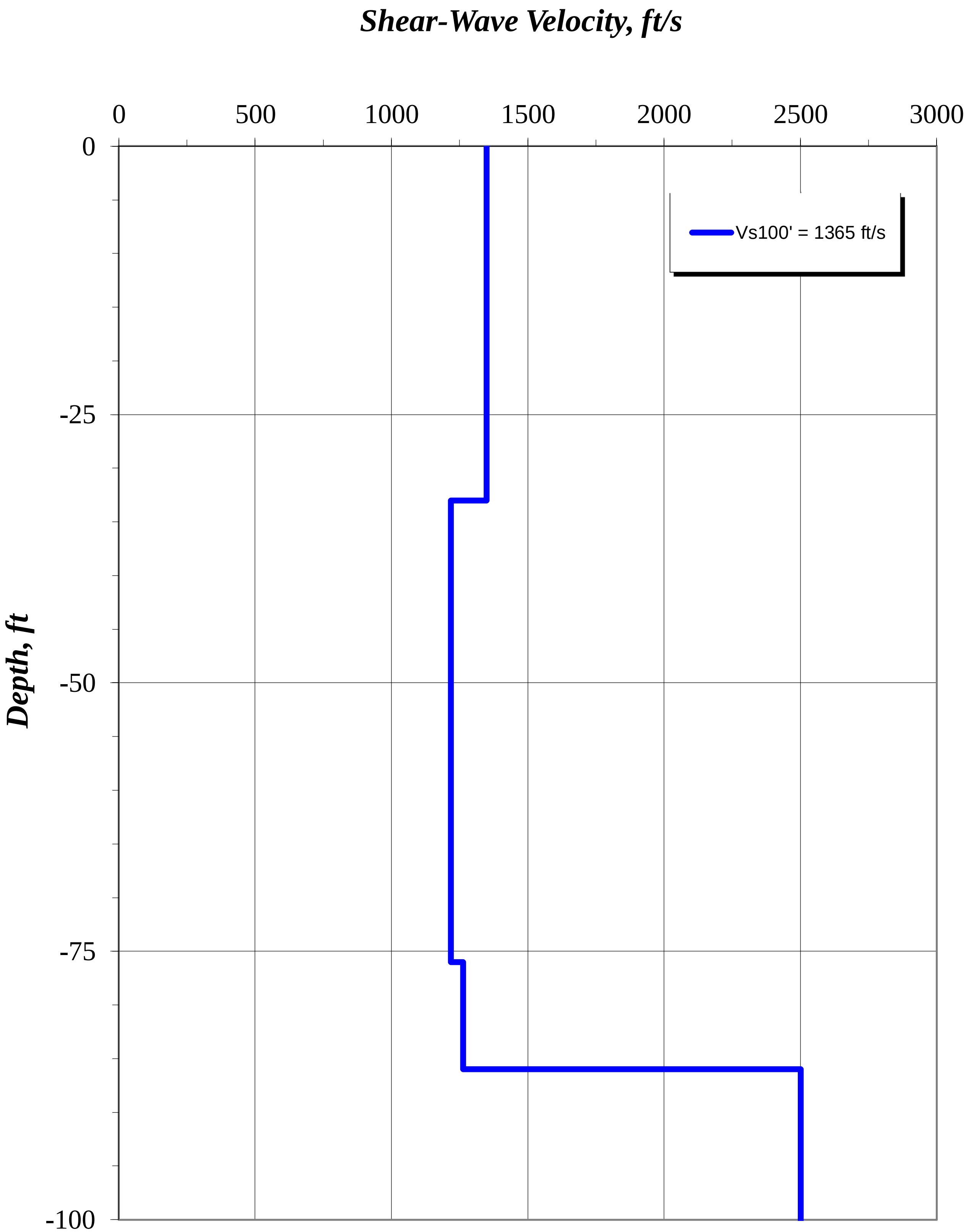
At the conclusion of the drilling activities, the borings were checked for the presence of groundwater. After which, the borings were backfilled with the auger cuttings and cement/bentonite grout. Borings in pavement areas were capped with cold patch asphalt. Our exploration services include storing the collected soil samples and making them available for inspection for 60 days from the report date. The samples will then be discarded unless requested otherwise.

Field Seismic Testing

Terracon utilized the SeisOpt® ReMi™ method to develop the full depth shear wave velocity profile at the site for use in determining the seismic site class. This method employs non-linear optimization technology to derive one-dimensional S-wave velocities from refraction microtremor (ambient noise) recordings using a typical seismograph and standard, low frequency, refraction geophones. We utilized 24 receivers (geophones) set along a straight-line array with a 15±-foot receiver spacing for a total length of about 345 feet along Array 1 shown on the attached Boring Location Plan (Exhibit A-2). Unfiltered, 30-second records were recorded using the background ‘noise’ created by the moving traffic and other ambient vibrations. The collected data, the response spectrum in the 5 to 40 Hz range, was processed using the computer software SeisOpt® ReMi™ by Optim, LLC with the results plotted as a conventional shear wave velocity vs. depth profile. The shear wave velocity profile obtained using the SeisOpt® ReMi™ data reduction method is shown on Exhibit A-4.

TEXAM Pressuremeter Testing

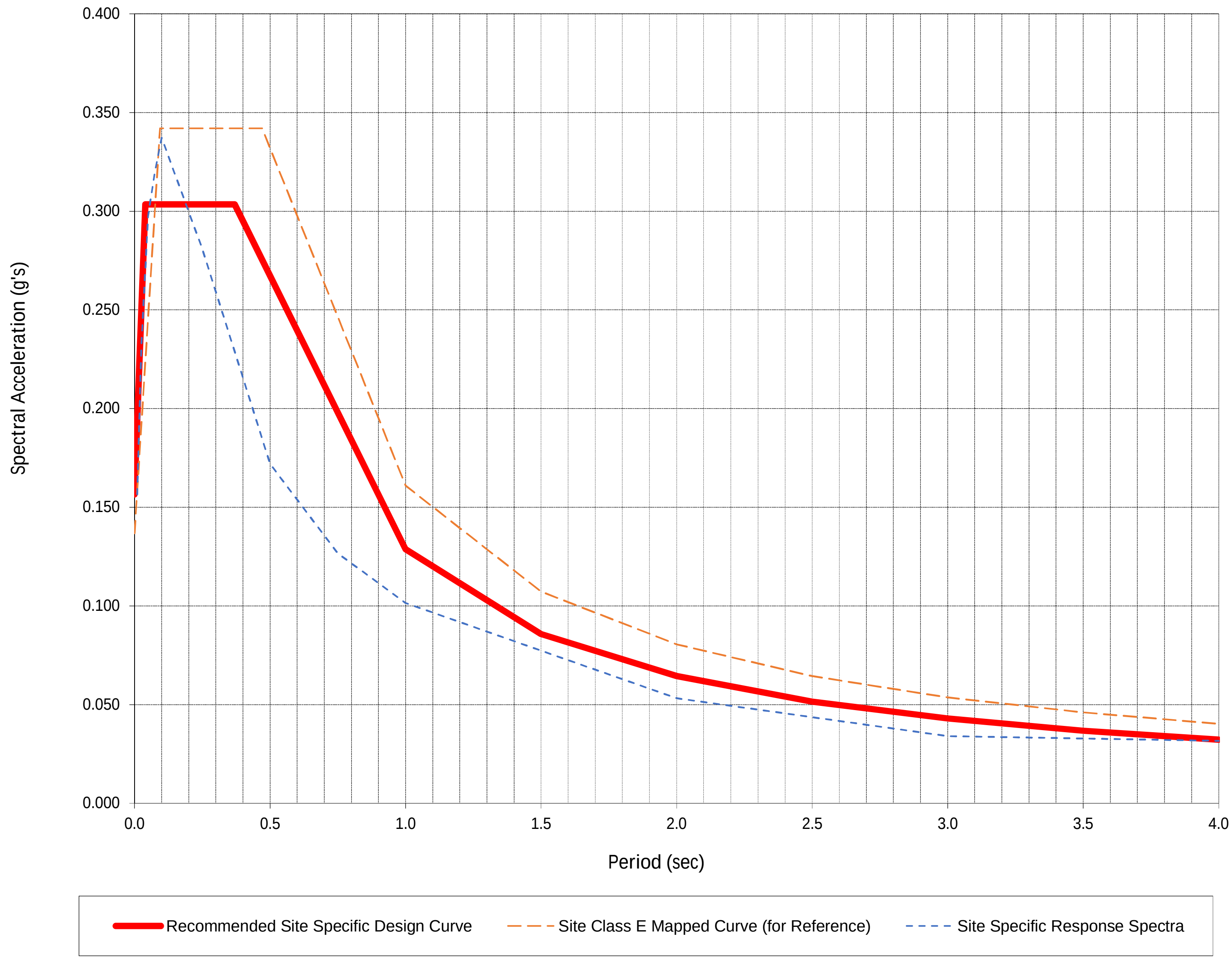
TEXAM Pressuremeter testing was performed Borings B-3, B-5, and B-7. One to three tests per location were performed at descending depth intervals. The pressuremeter is a device constructed to measure the stress/strain relationship of the soil/rock mass in-situ (limit pressure and pressuremeter modulus) which can be used to estimate bearing capacity and settlement potential. The pressuremeter has 2 major components, the first component is the read-out unit that remains above ground and the second is the pressure probe that is inserted into the borehole and is supported by pressure tubing (or tecalan) at the appropriate test depth. The probe consists of a metallic slotted casing and an inflatable rubber sheath which applies an even pressure to the walls of the borehole as hydraulic pressure from the read-out unit causes it to expand. As the pressure increases and the casing/sheath expands, the walls of the borehole begin to deform. The pressure inside the probe is held constant for a specific period of time and the increase in volume required to maintain the pressure is recorded. The collected data per test interval is presented in Appendix A.



Project Mngr. KJZ	Project No. 73155038	Terracon Consulting Engineers & Scientists	SHEAR WAVE VELOCITY PROFILE	Exhibit
Drawn By: JDF	Scale: n/a	521 CLEMSON ROAD COLUMBIA, SC 29229	W.J.B. Dorn VA Medical Center Parking Garage	A-4
Checked By: KJZ	File Name: A-4	PH. (803) 741-9000 FAX. (803) 741-9900	6439 Garners Ferry Road	
Approved By: PAM	Date: MAY2015		COLUMBIA, South Carolina	

	Recommended Site Specific Design Curve	
	0.000	0.156
T_0	0.040	0.304
T_S	0.370	0.304
	1.000	0.129
	1.500	0.086
	2.000	0.064
	2.500	0.052
	3.000	0.043
	3.500	0.037
	4.000	0.032

Recommended Site Specific Design Curve Parameters	
S_{DS} (g) =	0.30
S_{D1} (g) =	0.13
T_0 (sec) =	0.04
T_S (sec) =	0.37
PGA (g) =	0.16
PGA_M (g) =	0.22
C_{R1} =	0.84
C_{RS} =	0.85



DESIGN HORIZONTAL ACCERLATION RESPONSE SPECTRA AT GROUND SURFACE
2% IN 50 YEAR: 5% DAMPED
W.J.B Dorn VA Medical Center Parking Garage
6439 Garners Ferry Road, Columbia, South Carolina
Terracon Project Number: 73155038

Terracon

BORING LOG NO. B-1

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

CLIENT: Guidon Design Indianapolis, Indiana

SITE: W.B.J. Dorn VA Medical Center Columbia, South Carolina

LOCATION See Exhibit A-2

Northing: 779350.557 Easting: 2011418.494

Surface Elev.: 250 (Ft.)

GRAPHIC LOG	DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	0.1		250							
	3.0	**FILL - SANDY LEAN CLAY (CL)**, with trace organics and crushed aggregate, red, very stiff	247			X	5-12-16 N=28			
		SANDY SILT (ML), red, very stiff				X	2-9-10 N=19			
				5		X	8-10-17 N=27			
	12.0		238	10		X	3-13-14 N=27			
		SANDY SILT (ML), with rock fragments, red to tan, hard to very stiff		15		X	15-25-28 N=53			
		light reddish brown		20		X	8-18-26 N=44			
		light reddish brown		25	Cave-in	X	4-7-10 N=17			
		light brown		30		X	9-12-16 N=28			
	37.0		213	35		X	9-14-16 N=30			
		LEAN CLAY (CL), light gray and purple, hard, (Coastal Plain)		40		X	9-15-30 N=45			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:
83.6% SPT Hammer Efficiency

WATER LEVEL OBSERVATIONS

Groundwater not recorded due to drilling method

Groundwater not encountered after 24 hours

Cave-in at 25'

Terracon
521 Clemson Road
Columbia, South Carolina

Boring Started: 5/26/2015	Boring Completed: 5/27/2015
Drill Rig: CME-550X	Driller: J. Pawless
Project No.: 73155038	Exhibit: A-6

BORING LOG NO. B-1

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

CLIENT: Guidon Design Indianapolis, Indiana

SITE: W.B.J. Dorn VA Medical Center Columbia, South Carolina

LOCATION See Exhibit A-2

Northing: 779350.557 Easting: 2011418.494

Surface Elev.: 250 (Ft.)

GRAPHIC LOG	DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	LEAN CLAY (CL), light gray and purple, hard, (Coastal Plain) *(continued)*								
	gray to brown		45		X	19-33-43 N=76			
	dark gray		50		X	15-50-50/3"			
	light gray		55		X	12-32-50 N=82			
	pale gray		60		X	19-34-50 N=84			
	greenish gray		65		X	12-29-48 N=77			
	light gray 70.0	180	70		X	10-23-25 N=48			
	Boring Terminated at 70 Feet		75						
			80						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not recorded due to drilling method

Groundwater not encountered after 24 hours

Cave-in at 25'

Terracon
521 Clemson Road
Columbia, South Carolina

Boring Started: 5/26/2015	Boring Completed: 5/27/2015
Drill Rig: CME-550X	Driller: J. Pawless
Project No.: 73155038	Exhibit: A-6

BORING LOG NO. B-2

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

CLIENT: Guidon Design
Indianapolis, Indiana

SITE: W.B.J. Dorn VA Medical Center
Columbia, South Carolina

LOCATION See Exhibit A-2

Northing: 779280.753 Easting: 2011440.73

Surface Elev.: 254 (Ft.)

DEPTH	Description	ELEVATION (Ft.)
0.1	**TOPSOIL**, (1-1/2 inches)	254
5.5	**FILL - SANDY LEAN CLAY (CL)**, reddish brown to brown, very stiff to hard	248.5
22.0	**SILT (ML)**, trace sand, red and tan, very stiff to hard; little sand, light brown to pale yellow	232
27.0	**SANDY SILT (ML)**, pinkesh red, very stiff	227
32.0	**SILTY SAND (SM)**, with little gravel, fine to coarse grained, pale yellow, medium dense	222
37.0	**SILT (ML)**, with little mica, light brownish gray, very stiff	217
	SILTY SAND WITH GRAVEL (SM), light reddish brown, medium dense	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
			4-11-11 N=22			
5			7-21-18 N=39			
			6-10-13 N=23			
10			7-13-21 N=34	23	46-33-13	
15			13-27-24 N=51			
20			10-18-26 N=44	21		
25			7-11-15 N=26			
30			3-6-7 N=13	18		16
35			5-7-12 N=19			
40			4-6-11 N=17	21		14

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:
83.6% SPT Hammer Efficiency

WATER LEVEL OBSERVATIONS

Groundwater not recorded due to drilling method

Groundwater not encountered after 72 hours

Cave-in at 43'

Terracon
521 Clemson Road
Columbia, South Carolina

Boring Started: 5/22/2015	Boring Completed: 5/25/2015
Drill Rig: CME-550X	Driller: J. Pawless
Project No.: 73155038	Exhibit: A-7

BORING LOG NO. B-2

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

CLIENT: Guidon Design
Indianapolis, Indiana

SITE: W.B.J. Dorn VA Medical Center
Columbia, South Carolina

LOCATION See Exhibit A-2

Northing: 779280.753 Easting: 2011440.73

Surface Elev.: 254 (Ft.)

DEPTH	Material Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND WITH GRAVEL (SM), light reddish brown, medium dense *(continued)*								
42.0		212							
	SANDY SILT (ML), light brown to pale yellow, hard		43	Cave-in					
			45		X	10-15-18 N=33			
47.0		207							
	LEAN CLAY (CL), with little sand, reddish brown, very stiff, (Coastal Plain)		50		X	4-8-10 N=18	25	32-22-10	
52.0		202							
	LEAN CLAY (CL), gray to dark gray, hard		55		X	12-24-44 N=68			
			60		X	11-25-34 N=59			
			65		X	18-29-50 N=79	28		
			70		X	16-36-50 N=86			
75.0		179	75		X	17-32-50 N=82			
	Boring Terminated at 75 Feet		80						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
Groundwater not recorded due to drilling method
Groundwater not encountered after 72 hours
Cave-in at 43'

Terracon
521 Clemson Road
Columbia, South Carolina

Boring Started: 5/22/2015	Boring Completed: 5/25/2015
Drill Rig: CME-550X	Driller: J. Pawless
Project No.: 73155038	Exhibit: A-7

BORING LOG NO. B-3

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

CLIENT: Guidon Design
Indianapolis, Indiana

SITE: W.B.J. Dorn VA Medical Center
Columbia, South Carolina

LOCATION See Exhibit A-2

Northing: 779275.732 Easting: 2011351.079

Surface Elev.: 249 (Ft.)

DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Elastic Modulus (E)
	SANDY LEAN CLAY (CL), brown, medium stiff					5-3-3 N=6	
	SANDY LEAN CLAY (CL), red and brown, very stiff		5			10-12-16 N=28	
						7' to 9' Pressuremeter Test	764 ksf
	SANDY LEAN CLAY (CL), red and brown, hard		10			9-20-26 N=46	
	SANDY LEAN CLAY (CL), red and brown, very stiff		15			7-10-16 N=26	
						17' to 19' Pressuremeter Test	514 ksf
	SILTY SAND WITH GRAVEL (SM), fine to coarse grained, brown, medium dense		20			13-15-12 N=27	
	SILT (ML), white, hard		25			7-16-29 N=45	
						27' to 29' Pressuremeter Test	486 ksf
31.5	**SANDY SILT (ML)**, white, very stiff	217.5	30			8-10-12 N=22	
	Boring Terminated at 31.5 Feet		35				
			40				

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:
71.8% SPT Hammer Efficiency

WATER LEVEL OBSERVATIONS
Groundwater not recorded

Terracon
521 Clemson Road
Columbia, South Carolina

Boring Started: 6/2/2015	Boring Completed: 6/2/2015
Drill Rig: CME-45	Driller: J. Pawless
Project No.: 73155038	Exhibit: A-8

BORING LOG NO. B-4

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

CLIENT: Guidon Design Indianapolis, Indiana

SITE: W.B.J. Dorn VA Medical Center Columbia, South Carolina

LOCATION See Exhibit A-2

Northing: 779245.961 Easting: 2011533.108

Surface Elev.: 248 (Ft.)

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDY LEAN CLAY (CL), with glass debris, red, very stiff to stiff				X	7-16-7 N=23			
					X	2-3-5 N=8			
5.5		242.5	5						
	SANDY LEAN CLAY (CL), red, very stiff				X	5-6-9 N=15			
					X	6-9-16 N=25			
			10						
12.0		236							
	SANDY SILT (ML), red, orange, tan and gray, very stiff to hard				X	5-7-12 N=19			
			15						
	with gravel				X	18-21-24 N=45			
			20						
22.0		226							
	LEAN CLAY (CL), purple and gray, very stiff				X	5-10-14 N=24			
			25						
	with trace mica				X	7-10-17 N=27			
			30						
32.0		216							
	SILTY SAND (SM), with trace mica, fine to medium grained, white, medium dense				X	6-8-8 N=16			
			35						
37.0		211							
	SANDY SILT (ML), purple, orange and gray, very stiff				X	7-7-10 N=17			
			40						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:
83.6% SPT Hammer Efficiency

WATER LEVEL OBSERVATIONS

Groundwater not recorded due to drilling method

Groundwater not encountered after 24 hours

Cave-in at 58'

Terracon
521 Clemson Road
Columbia, South Carolina

Boring Started: 6/1/2015	Boring Completed: 6/2/2015
Drill Rig: CME-550X	Driller: J. Pawless
Project No.: 73155038	Exhibit: A-9

BORING LOG NO. B-4

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

CLIENT: Guidon Design Indianapolis, Indiana

SITE: W.B.J. Dorn VA Medical Center Columbia, South Carolina

LOCATION See Exhibit A-2

Northing: 779245.961 Easting: 2011533.108

Surface Elev.: 248 (Ft.)

DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SANDY SILT (ML), purple, orange and gray, very stiff *(continued)*								
42.0		206							
	LEAN CLAY (CL), gray, hard, (Coastal Plain)								
			45		X	20-29-40 N=69			
			50		X	19-49-50 N=99			
			55		X	15-30-42 N=72			
			58	Cave-in					
			60		X	17-31-41 N=72			
			65		X	20-35-50/4"			
67.0		181							
	SANDY SILT (ML), with trace mica, purple and yellowish brown, very stiff								
70.0		178	70		X	9-10-10 N=20			
	Boring Terminated at 70 Feet								

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not recorded due to drilling method

Groundwater not encountered after 24 hours

Cave-in at 58'

Terracon
521 Clemson Road
Columbia, South Carolina

Boring Started: 6/1/2015	Boring Completed: 6/2/2015
Drill Rig: CME-550X	Driller: J. Pawless
Project No.: 73155038	Exhibit: A-9

BORING LOG NO. B-5

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

CLIENT: Guidon Design, Indianapolis, Indiana

SITE: W.B.J. Dorn VA Medical Center, Columbia, South Carolina

LOCATION See Exhibit A-2

Northing: 779216.934 Easting: 2011501.301

Surface Elev.: 248 (Ft.)

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Elastic Modulus (E)
	SANDY LEAN CLAY (CL), red, very stiff					4-8-10 N=18	
			5			4' to 6' Pressuremeter Test	469 ksf
7.3		240.5					
	SANDY SILT (ML), with clay, brown, very stiff to hard					11-16-21 N=37	
			10				
	with gravel below 13.5'					1-5-11 N=16	
			15				
						4-16-18 N=34	
			20				
22.0		226					
	LEAN CLAY (CL), light gray to purple, hard					8-16-19 N=35	
25.0		223	25				
	Boring Terminated at 25 Feet						
			30				
			35				
			40				

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:
71.8% SPT Hammer Efficiency

WATER LEVEL OBSERVATIONS

Groundwater not recorded

Terracon
521 Clemson Road
Columbia, South Carolina

Boring Started: 6/3/2015	Boring Completed: 6/3/2015
Drill Rig: CME-45	Driller: J. Pawless
Project No.: 73155038	Exhibit: A-10

BORING LOG NO. B-6

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

CLIENT: Guidon Design
Indianapolis, Indiana

SITE: W.B.J. Dorn VA Medical Center
Columbia, South Carolina

LOCATION See Exhibit A-2

Northing: 779163.902 Easting: 2011444.438

Surface Elev.: 253 (Ft.)

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.1	**TOPSOIL**, (1 inch)	253							
3.0	**FILL - SANDY LEAN CLAY (CL)**, with little crushed aggregate, red, very stiff	250			X	12-13-16 N=29			
5.5	**FILL - SILTY SAND (SM)**, fine to medium grained, strong brown, medium dense	247.5	5		X	20-16-9 N=25			
12.0	**SILT (ML)**, red, medium stiff to stiff	241	10		X	3-3-2 N=5			
					X	2-5-8 N=13			
17.0	**SILT (ML)**, with little sand, red, hard	236	15		X	8-16-16 N=32			
27.0	**SANDY SILT (ML)**, brown to reddish brown, hard to very stiff	226	20		X	7-14-18 N=32			
			25		X	6-8-9 N=17	13		
32.0	**SILTY SAND WITH GRAVEL (SM)**, brown, dense	221	30		X	13-15-16 N=31			12
37.0	**SILT (ML)**, with little mica, light purple, very stiff	216	35		X	6-9-9 N=18			
	SANDY SILT (ML), with silty sand seams, very stiff		40		X	10-8-9 N=17			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:
83.6% SPT Hammer Efficiency

WATER LEVEL OBSERVATIONS

Groundwater not recorded due to drilling method

Groundwater not encountered after 24 hours

Cave-in at 45'

Terracon
521 Clemson Road
Columbia, South Carolina

Boring Started: 5/26/2015	Boring Completed: 5/27/2015
Drill Rig: CME-550X	Driller: J. Pawless
Project No.: 73155038	Exhibit: A-11

BORING LOG NO. B-6

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

CLIENT: Guidon Design, Indianapolis, Indiana

SITE: W.B.J. Dorn VA Medical Center, Columbia, South Carolina

LOCATION See Exhibit A-2

Northing: 779163.902 Easting: 2011444.438

Surface Elev.: 253 (Ft.)

DEPTH	Description	ELEVATION (Ft.)
	SANDY SILT (ML), with silty sand seams, very stiff *(continued)*	
42.0		211
	LEAN CLAY (CL), gray, hard, (Coastal Plain)	
52.0		201
	FAT CLAY (CH), light gray, hard	
57.0		196
	LEAN CLAY (CL), pale gray, hard	
70.0		183
	Boring Terminated at 70 Feet	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
44-45.5	Cave-in at 45'	X	16-24-35 N=59			
49-50.5		X	22-29-49 N=78			
54-55.5		X	15-19-26 N=45	28	55-25-30	
59-60.5		X	12-25-37 N=62			
64-65		X	20-40-50/5"			
69-70		X	15-31-50/3"			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS
Groundwater not recorded due to drilling method
Groundwater not encountered after 24 hours
Cave-in at 45'

Terracon
521 Clemson Road
Columbia, South Carolina

Boring Started: 5/26/2015	Boring Completed: 5/27/2015
Drill Rig: CME-550X	Driller: J. Pawless
Project No.: 73155038	Exhibit: A-11

BORING LOG NO. B-7

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

CLIENT: Guidon Design Indianapolis, Indiana

SITE: W.B.J. Dorn VA Medical Center Columbia, South Carolina

LOCATION See Exhibit A-2

Northing: 779158.321 Easting: 2011556.675

Surface Elev.: 247 (Ft.)

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	Elastic Modulus (E)
	CL - SANDY LEAN CLAY (CL), fine to medium grained, red, stiff					5-4-4 N=8	
	CL - SANDY LEAN CLAY (CL), fine to medium grained, red to brown, very stiff		5			5-8-13 N=21	
						7' to 9' Pressuremeter Test	469 ksf
	CL - SANDY LEAN CLAY (CL), with little gravel, fine to coarse grained, red to brown, hard		10			12-17-25 N=42	
	CL - SANDY LEAN CLAY (CL), fine to coarse grained, red, very stiff					8-11-15 N=26	
			15			15' to 17' Pressuremeter Test	262 ksf
	SILTY SAND (SM), fine to coarse grained, red to brown, dense					2-16-21 N=37	
	SILTY SAND WITH GRAVEL (SM), fine to coarse grained, red to brown, dense		20			2-22-31 N=53	
	CLAYEY SAND (SC), fine grained, gray, medium dense		25			6-6-13 N=19	
			30			29' to 31' Pressuremeter Test	379 ksf
33.5		213.5				4-10-13 N=23	
	Boring Terminated at 33.5 Feet		35				
			40				

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:
71.8% SPT Hammer Efficiency

WATER LEVEL OBSERVATIONS
Groundwater not recorded

Terracon
521 Clemson Road
Columbia, South Carolina

Boring Started: 6/3/2015	Boring Completed: 6/3/2015
Drill Rig: CME-45	Driller: J. Pawless
Project No.: 73155038	Exhibit: A-12

BORING LOG NO. B-8

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

CLIENT: Guidon Design Indianapolis, Indiana

SITE: W.B.J. Dorn VA Medical Center Columbia, South Carolina

LOCATION See Exhibit A-2

Northing: 779128.686 Easting: 2011625.84

Surface Elev.: 247 (Ft.)

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
0.1	**TOPSOIL**, (1 inch)	247					
	FILL - SANDY CLAY (CL), red, stiff			5-7-5 N=12			
				2-6-7 N=13			
5.5	**LEAN CLAY (CL)**, reddish brown to brown, very stiff to hard	241.5	5	8-9-12 N=21			
			10	6-12-13 N=25	17	42-21-21	
			15	6-12-15 N=27			
	with gravel		20	15-23-20 N=43			
22.0	**SILTY SAND WITH GRAVEL (SM)**, brownish red, medium dense	225	25	7-8-8 N=16			
27.0	**SILTY SAND (SM)**, brown, medium dense	220	30	6-8-10 N=18	24	NP	25
	with gravel		35	5-6-7 N=13	27		19
37.0	**SILTY SAND (SM)**, with gravel, brownish purple, loose	210	40	1-4-5 N=9			

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:
83.6% SPT Hammer Efficiency

WATER LEVEL OBSERVATIONS
Groundwater not recorded due to drilling method
Groundwater not encountered after 24 hours
Cave-in at 60'

Terracon
521 Clemson Road
Columbia, South Carolina

Boring Started: 5/27/2015	Boring Completed: 5/28/2015
Drill Rig: CME-550X	Driller: J. Pawless
Project No.: 73155038	Exhibit: A-13

BORING LOG NO. B-8

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

CLIENT: Guidon Design, Indianapolis, Indiana

SITE: W.B.J. Dorn VA Medical Center, Columbia, South Carolina

LOCATION See Exhibit A-2

Northing: 779128.686 Easting: 2011625.84

Surface Elev.: 247 (Ft.)

DEPTH	Description	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
	SILTY SAND (SM), with gravel, brownish purple, loose *(continued)*								
42.0		205							
	LEAN CLAY (CL), light gray, hard								
			45		X	13-25-38 N=63			
			50		X	9-16-24 N=40	26	48-24-24	
			55		X	12-29-42 N=71			
			60	Cave-in	X	11-27-40 N=67			
			65		X	17-37-50 N=87			
70.0		177	70		X	13-23-35 N=58			
	Boring Terminated at 70 Feet								
			75						
			80						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not recorded due to drilling method

Groundwater not encountered after 24 hours

Cave-in at 60'

Terracon
521 Clemson Road
Columbia, South Carolina

Boring Started: 5/27/2015	Boring Completed: 5/28/2015
Drill Rig: CME-550X	Driller: J. Pawless
Project No.: 73155038	Exhibit: A-13

BORING LOG NO. B-9

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

CLIENT: Guidon Design
Indianapolis, Indiana

SITE: W.B.J. Dorn VA Medical Center
Columbia, South Carolina

LOCATION See Exhibit A-2

Northing: 779055.613 Easting: 2011533.229

Surface Elev.: 252 (Ft.)

Depth	Material Description	Elevation (Ft.)	Sample Depth (Ft.)	Field Test Results
0.2	(2 inches)	252		
3.0	**FILL - SANDY LEAN CLAY (CL)**, strong brown to reddish brown, very stiff	249		10-12-15 N=27
5.5	**FILL - SILTY SAND (SM)**, fine to medium grained, strong brown, medium dense	246.5	5	10-9-8 N=17
12.0	**SANDY LEAN CLAY (CL)**, brown to light brown, stiff	240		4-4-5 N=9
			10	4-4-5 N=9
17.0	**SANDY SILT (ML)**, red to tan, very stiff	235	15	8-11-15 N=26
27.0	**SILTY SAND (SM)**, with quartz crystals, fine to coarse grained, pinkesh red to pale yellow, dense	225	20	8-17-20 N=37
			25	14-16-22 N=38
32.0	**SILTY SAND WITH GRAVEL (SM)**, fine to coarse grained, light brown, medium dense	220	30	11-13-14 N=27
	SANDY SILT (ML), pale yellow to light brown, very stiff		35	5-8-8 N=16
			40	7-8-9 N=17

Columns also headed: GRAPHIC LOG, WATER LEVEL OBSERVATIONS, SAMPLE TYPE, WATER CONTENT (%), ATTERBERG LIMITS LL-PL-PI, PERCENT FINES.

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:
83.6% SPT Hammer Efficiency

WATER LEVEL OBSERVATIONS
Groundwater not recorded due to drilling method
Groundwater not encountered after 72 hours
Cave-in at 49'

Terracon
521 Clemson Road
Columbia, South Carolina

Boring Started: 5/22/2015	Boring Completed: 5/25/2015
Drill Rig: CME-550X	Driller: J. Pawless
Project No.: 73155038	Exhibit: A-14

BORING LOG NO. B-9

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage	CLIENT: Guidon Design Indianapolis, Indiana
SITE: W.B.J. Dorn VA Medical Center Columbia, South Carolina	

LOCATION See Exhibit A-2

Northing: 779055.613 Easting: 2011533.229

Surface Elev.: 252 (Ft.)

GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
		SANDY SILT (ML), pale yellow to light brown, very stiff *(continued)*								
	42.0		210							
		LEAN CLAY (CL), red, gray and purple, hard								
				45		X	9-15-25 N=40			
		light gray and purple			Cave-in	X	14-31-40 N=71			
				50						
		dark gray		55		X	30-36-40 N=76			
		light gray		60		X	17-35-50/5"			
				65		X	11-32-50 N=82			
						X	15-35-50/5"			
	70.0		182	70						
		Boring Terminated at 70 Feet								
				75						
				80						

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with cement-bentonite grout upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

Groundwater not recorded due to drilling method
Groundwater not encountered after 72 hours
Cave-in at 49'

Terracon
521 Clemson Road
Columbia, South Carolina

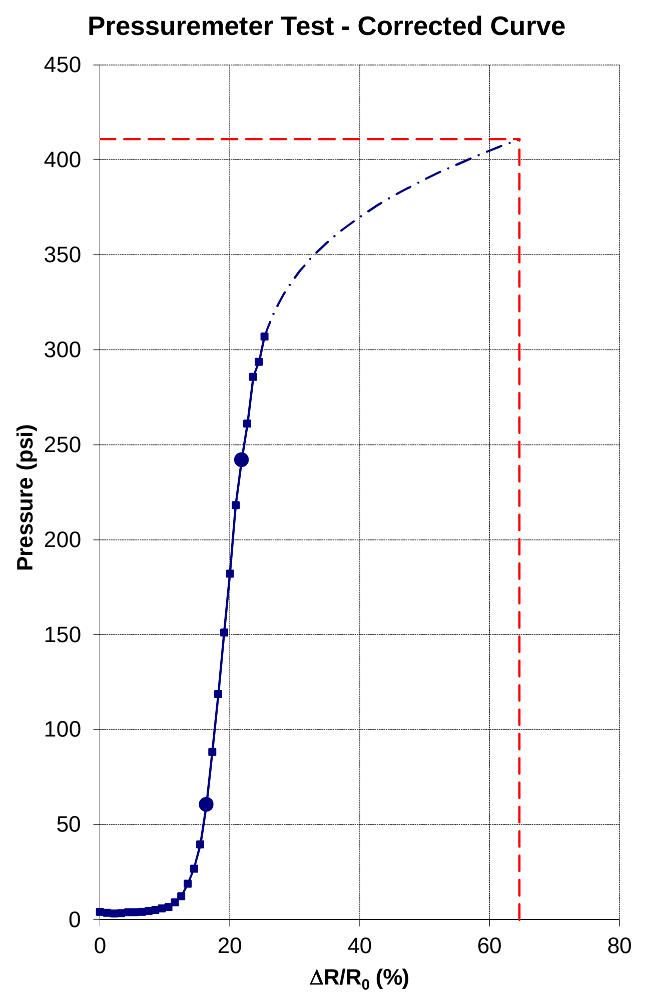
Boring Started: 5/22/2015	Boring Completed: 5/25/2015
Drill Rig: CME-550X	Driller: J. Pawless
Project No.: 73155038	Exhibit: A-14

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO LOG-DEPTH TO BOTTOM OF PAGE 73155038 - VA HOSPITAL BORING LOGS.GPJ LOGS.GPJ 7/13/15

TEXAM Pressuremeter Test

Project name:	W.J.B. Dorn VA Med. Ctr. Parking Gar.	Use of a slotted casing:	No
Borehole name:	B-3	Test depth:	8.00 ft[1]
Test date: (mm/dd/yyyy)	06/02/2015	Manometer height above ground:	1.00 ft
Test number:	Test #1	Poisson's coefficient:	0.33
Probe size:	N	Fluid density:	1.024

Raw Readings		Corrected Readings			
Pressure psi	Volume in³	Pressure psi	Volume in³	$\Delta R/R_0$ %	
0	0.0	4	0.0	0.00	
0	2.4	4	2.4	1.11	
0	4.9	3	4.9	2.20	
1	7.3	3	7.3	3.28	
1	9.8	4	9.8	4.35	
2	12.2	4	12.2	5.42	
2	14.6	4	14.6	6.46	
3	17.1	5	17.1	7.50	
4	19.5	5	19.5	8.53	
5	22.0	6	22.0	9.55	
6	24.4	7	24.4	10.56	
9	26.9	9	26.8	11.56	
12	29.3	12	29.3	12.55	
19	31.7	19	31.7	13.53	
27	34.2	27	34.1	14.50	
40	36.6	40	36.5	15.45	
61	39.1	61	38.9	16.39	◄
89	41.5	88	41.3	17.31	
119	43.9	119	43.6	18.22	
152	46.4	151	46.0	19.13	
183	48.8	182	48.3	20.03	
219	51.3	218	50.7	20.91	
243	53.7	242	53.0	21.81	◄
262	56.1	261	55.4	22.70	
286	58.6	286	57.8	23.58	
294	61.0	294	60.2	24.47	
308	63.5	307	62.6	25.34	



Test Results

Pressiometer modulus E:	**5,306 psi**
Ultimate pressure P_L:	**411 psi**
Ratio E / P_L:	12.91
Yield pressure P_F:	242 psi
Ratio P_L / P_F:	1.70

Remarks

Notes: See log for Boring B-3 for additional information.

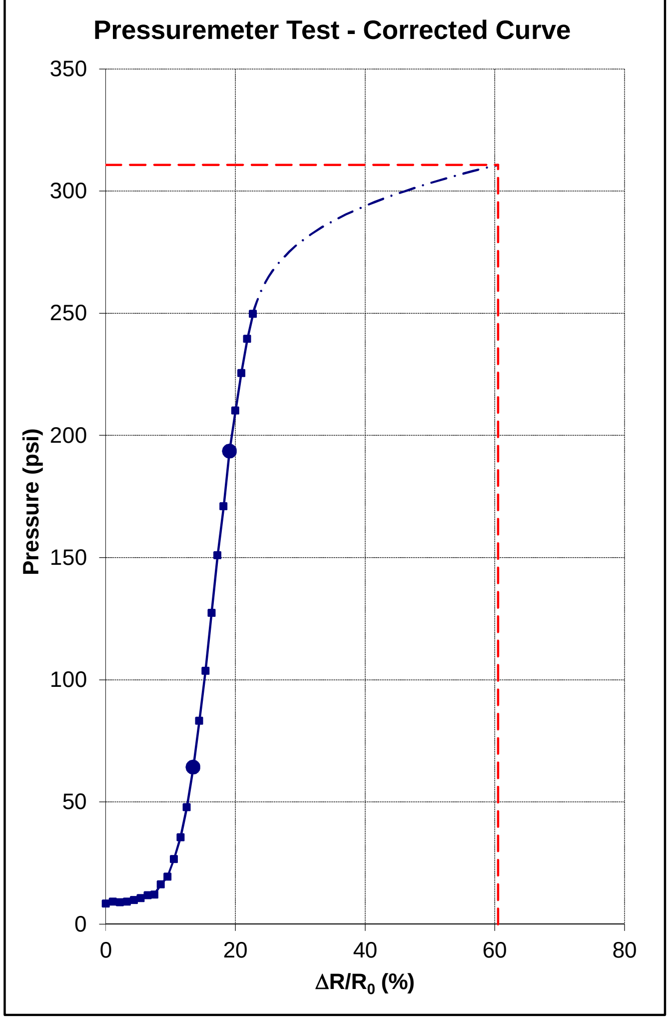
1. Center of probe

TEXAM COMPANION V.3.3

TEXAM Pressuremeter Test

Project name:	W.J.B. Dorn VA Med. Ctr. Parking Gar.	Use of a slotted casing:	No
Borehole name:	B-3	Test depth:	18.00 ft[1]
Test date: (mm/dd/yyyy)	06/02/2015	Manometer height above ground:	1.00 ft
Test number:	Test #2	Poisson's coefficient:	0.33
Probe size:	N	Fluid density:	1.024

Raw Readings		Corrected Readings			
Pressure psi	Volume in³	Pressure psi	Volume in³	$\Delta R/R_0$ %	
0	0.0	8	0.0	0.00	
1	2.4	9	2.4	1.11	
1	4.9	9	4.9	2.20	
2	7.3	9	7.3	3.28	
3	9.8	10	9.8	4.35	
4	12.2	11	12.2	5.41	
6	14.6	12	14.6	6.46	
6	17.1	12	17.1	7.50	
11	19.5	16	19.5	8.53	
14	22.0	19	21.9	9.54	
21	24.4	27	24.4	10.55	
31	26.9	36	26.8	11.54	
43	29.3	48	29.2	12.52	
60	31.7	64	31.6	13.48	◄
79	34.2	83	34.0	14.44	
99	36.6	104	36.3	15.39	
123	39.1	127	38.7	16.32	
147	41.5	151	41.1	17.25	
167	43.9	171	43.5	18.17	
190	46.4	194	45.9	19.09	◄
206	48.8	210	48.3	20.00	
222	51.3	225	50.7	20.91	
236	53.7	239	53.1	21.81	
246	56.1	250	55.5	22.71	



Test Results

Pressiometer modulus E:	**3,570 psi**
Ultimate pressure P_L:	**311 psi**
Ratio E / P_L:	11.49
Yield pressure P_F:	194 psi
Ratio P_L / P_F:	1.61

Remarks

Notes: See log for Boring B-3 for additional information.

1. Center of probe

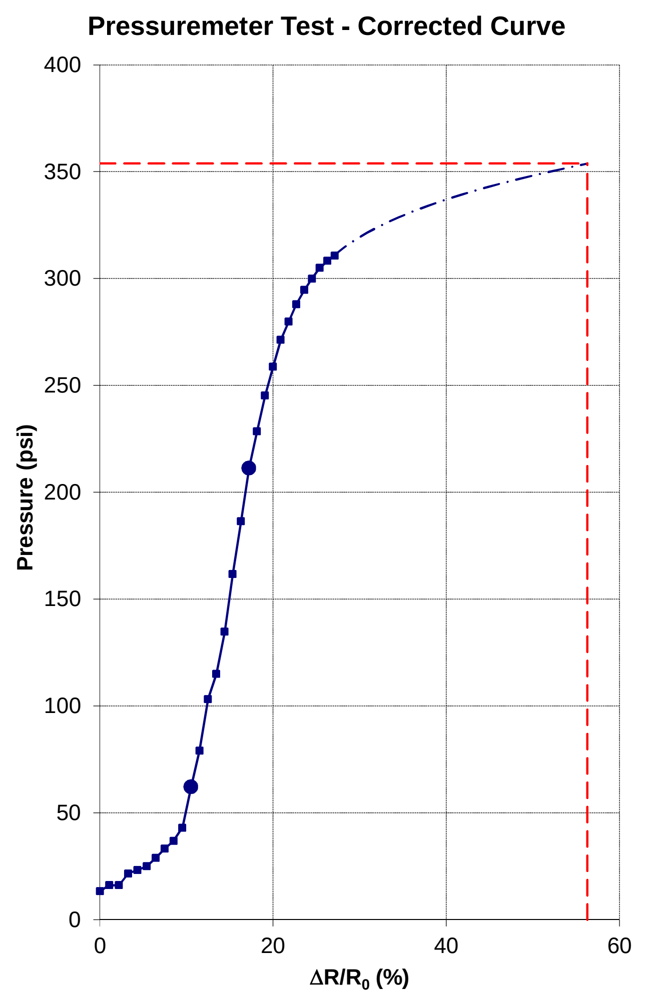
TEXAM COMPANION V.3.3

Terracon

TEXAM Pressuremeter Test

Project name:	W.J.B. Dorn VA Med. Ctr. Parking Gar.	Use of a slotted casing:	No
Borehole name:	B-3	Test depth:	29.00 ft[1]
Test date: (mm/dd/yyyy)	06/02/2015	Manometer height above ground:	1.00 ft
Test number:	Test #3	Poisson's coefficient:	0.33
Probe size:	N	Fluid density:	1.024

Raw Readings		Corrected Readings			
Pressure psi	Volume in³	Pressure psi	Volume in³	$\Delta R/R_0$ %	
0	0.0	13	0.0	0.00	
4	2.4	16	2.4	1.10	
5	4.9	16	4.9	2.20	
11	7.3	22	7.3	3.27	
12	9.8	23	9.7	4.34	
15	12.2	25	12.2	5.40	
19	14.6	29	14.6	6.45	
23	17.1	33	17.0	7.48	
27	19.5	37	19.5	8.51	
33	22.0	43	21.9	9.52	
53	24.4	62	24.3	10.52	◄
70	26.9	79	26.7	11.50	
94	29.3	103	29.1	12.47	
106	31.7	115	31.5	13.44	
126	34.2	135	33.9	14.40	
153	36.6	162	36.2	15.34	
178	39.1	186	38.6	16.28	
203	41.5	211	41.0	17.21	◄
220	43.9	229	43.4	18.14	
237	46.4	245	45.8	19.06	
250	48.8	259	48.2	19.98	
263	51.3	271	50.6	20.89	
272	53.7	280	53.0	21.80	
280	56.1	288	55.5	22.70	
286	58.6	295	57.9	23.60	
292	61.0	300	60.3	24.49	
297	63.5	305	62.7	25.38	
300	65.9	308	65.2	26.26	
303	68.3	311	67.6	27.14	



Remarks

Notes: See log for Boring B-3 for additional information.

Test Results

Pressiometer modulus E:	**3,378 psi**
Ultimate pressure P_L:	**354 psi**
Ratio E / P_L:	9.55
Yield pressure P_F:	211 psi
Ratio P_L / P_F:	1.67

1. Center of probe

TEXAM COMPANION V.3.3

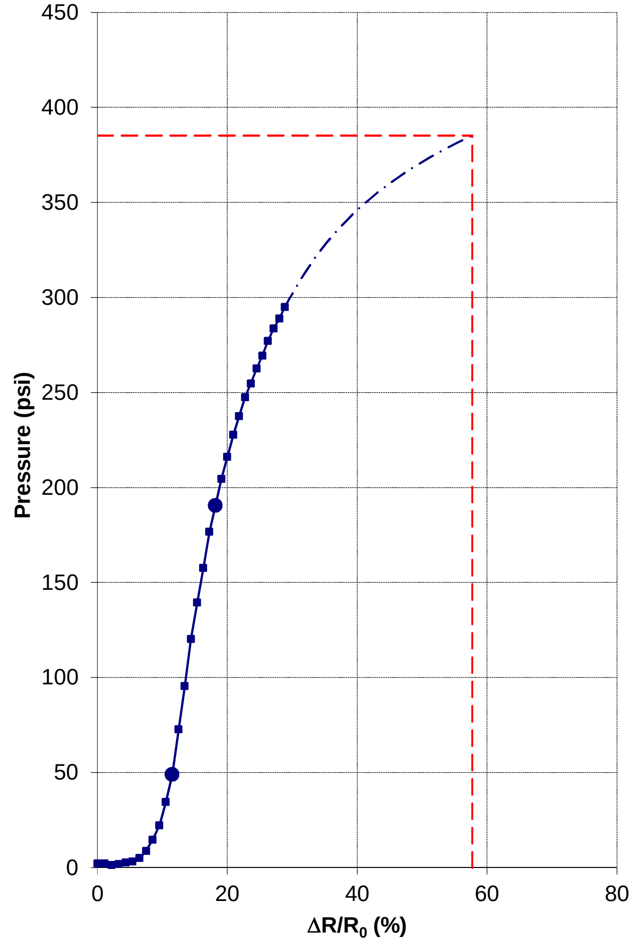
Terracon

TEXAM Pressuremeter Test

Project name:	W.J.B. Dorn VA Med. Ctr. Parking Gar.	Use of a slotted casing:	No
Borehole name:	B-5	Test depth:	4.00 ft[1]
Test date: (mm/dd/yyyy)	06/03/2015	Manometer height above ground:	1.00 ft
Test number:	Test #1	Poisson's coefficient:	0.33
Probe size:	N	Fluid density:	1.024

Raw Readings		Corrected Readings		
Pressure psi	Volume in³	Pressure psi	Volume in³	$\Delta R/R_0$ %
0	0.0	2	0.0	0.00
1	2.4	2	2.4	1.11
1	4.9	1	4.9	2.20
2	7.3	2	7.3	3.28
3	9.8	3	9.8	4.35
4	12.2	3	12.2	5.41
7	14.6	5	14.6	6.46
11	17.1	9	17.1	7.50
17	19.5	15	19.5	8.52
25	22.0	22	21.9	9.53
37	24.4	35	24.3	10.53
52	26.9	49	26.7	11.52
76	29.3	73	29.1	12.49
98	31.7	96	31.5	13.45
123	34.2	120	33.9	14.40
143	36.6	140	36.3	15.35
161	39.1	158	38.7	16.30
180	41.5	177	41.1	17.23
194	43.9	191	43.5	18.16
208	46.4	204	45.9	19.09
220	48.8	216	48.3	20.01
231	51.3	228	50.7	20.92
241	53.7	238	53.1	21.83
251	56.1	247	55.5	22.73
258	58.6	255	57.9	23.63
266	61.0	263	60.4	24.51
273	63.5	269	62.8	25.40
281	65.9	277	65.2	26.28
288	68.3	284	67.6	27.15
293	70.8	289	70.1	28.02
299	73.2	295	72.5	28.88

Pressuremeter Test - Corrected Curve



Remarks

Notes: See log for Boring B-5 for additional information

Test Results

Pressiometer modulus E:	**3,257 psi**
Ultimate pressure P_L:	**385 psi**
Ratio E / P_L:	8.46
Yield pressure P_F:	191 psi
Ratio P_L / P_F:	2.02

1. Center of probe

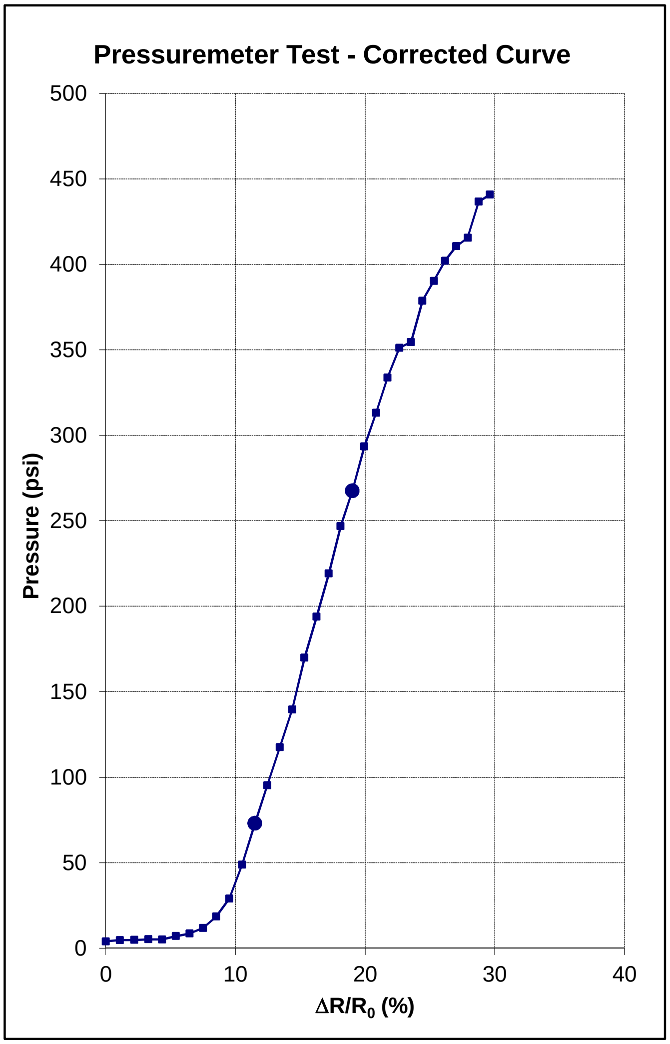
TEXAM COMPANION V.3.3

Terracon

TEXAM Pressuremeter Test

Project name:	W.J.B. Dorn VA Med. Ctr. Parking Gar.	Use of a slotted casing:	No
Borehole name:	B-7	Test depth:	8.00 ft[1]
Test date: (mm/dd/yyyy)	06/03/2015	Manometer height above ground:	1.00 ft
Test number:	Test #1	Poisson's coefficient:	0.33
Probe size:	N	Fluid density:	1.024

Raw Readings		Corrected Readings			
Pressure psi	Volume in³	Pressure psi	Volume in³	$\Delta R/R_0$ %	
0	0.0	4	0.0	0.00	
2	2.4	5	2.4	1.10	
3	4.9	5	4.9	2.20	
3	7.3	5	7.3	3.28	
4	9.8	5	9.8	4.35	
6	12.2	7	12.2	5.41	
8	14.6	9	14.6	6.46	
11	17.1	12	17.1	7.50	
18	19.5	18	19.5	8.52	
29	22.0	29	21.9	9.53	
49	24.4	49	24.3	10.52	
73	26.9	73	26.7	11.50	◄
95	29.3	95	29.1	12.47	
118	31.7	118	31.4	13.43	
140	34.2	140	33.8	14.39	
170	36.6	170	36.2	15.33	
195	39.1	194	38.6	16.26	
220	41.5	219	41.0	17.19	
248	43.9	247	43.3	18.11	
268	46.4	268	45.7	19.03	◄
294	48.8	293	48.1	19.94	
314	51.3	313	50.5	20.84	
335	53.7	334	52.9	21.74	
352	56.1	351	55.3	22.64	
356	58.6	355	57.7	23.54	
380	61.0	379	60.1	24.41	
391	63.5	390	62.5	25.29	
403	65.9	402	64.9	26.17	
412	68.3	411	67.3	27.04	
417	70.8	416	69.8	27.91	
438	73.2	437	72.1	28.76	
442	75.7	441	74.6	29.61	



Test Results

Pressiometer modulus E:	**3,961 psi**
Ultimate pressure P_L:	**n.a.**
Ratio E / P_L:	n.a.
Yield pressure P_F:	268 psi
Ratio P_L / P_F:	n.a.

Remarks

Notes: See boring log for Boring B-7 for additional information.

1. Center of probe

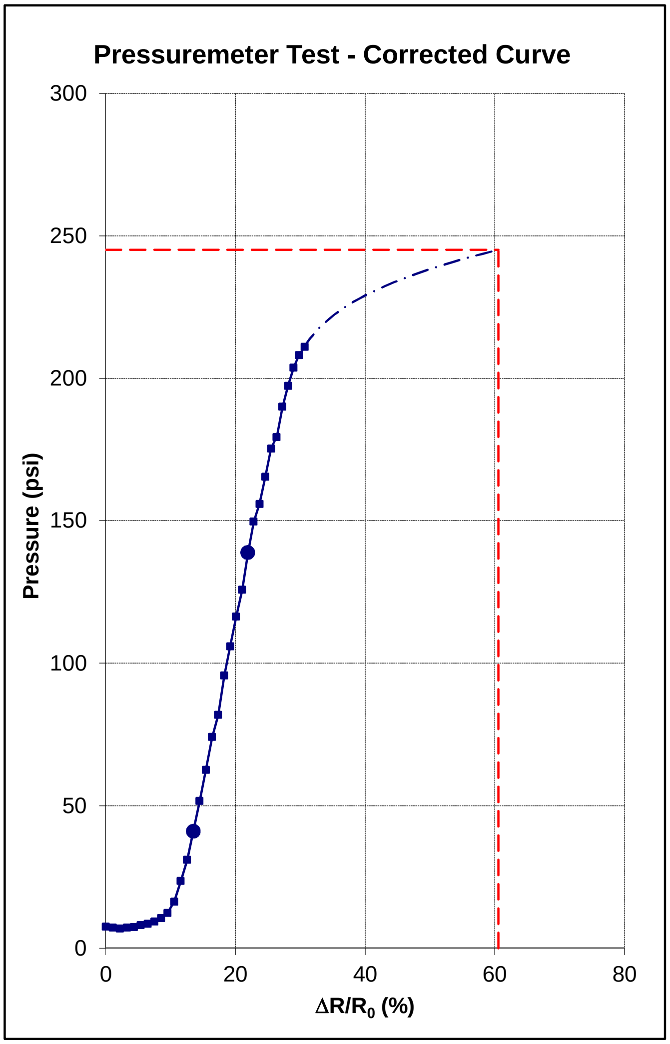
TEXAM COMPANION V.3.3

Terracon

TEXAM Pressuremeter Test

Project name:	W.J.B. Dorn VA Med. Ctr. Parking Gar.	Use of a slotted casing:	No
Borehole name:	B-7	Test depth:	16.00 ft[1]
Test date: (mm/dd/yyyy)	06/03/2015	Manometer height above ground:	1.00 ft
Test number:	Test #2	Poisson's coefficient:	0.33
Probe size:	N	Fluid density:	1.024

Raw Readings		Corrected Readings			
Pressure psi	Volume in³	Pressure psi	Volume in³	$\Delta R/R_0$ %	
0	0.0	8	0.0	0.00	
1	2.4	7	2.4	1.11	
1	4.9	7	4.9	2.20	
2	7.3	7	7.3	3.28	
2	9.8	7	9.8	4.35	
3	12.2	8	12.2	5.41	
4	14.6	9	14.6	6.46	
5	17.1	9	17.1	7.50	
6	19.5	11	19.5	8.53	
8	22.0	12	21.9	9.55	
13	24.4	16	24.4	10.56	
20	26.9	24	26.8	11.55	
28	29.3	31	29.2	12.54	
38	31.7	41	31.6	13.51	◄
48	34.2	52	34.1	14.48	
59	36.6	63	36.5	15.43	
71	39.1	74	38.9	16.38	
79	41.5	82	41.3	17.33	
93	43.9	96	43.7	18.26	
103	46.4	106	46.1	19.19	
114	48.8	116	48.5	20.11	
123	51.3	126	51.0	21.02	
136	53.7	139	53.4	21.92	◄
147	56.1	150	55.8	22.82	
153	58.6	156	58.2	23.72	
163	61.0	165	60.6	24.61	
173	63.5	175	63.0	25.49	
177	65.9	179	65.5	26.37	
188	68.3	190	67.9	27.24	
195	70.8	197	70.3	28.10	
202	73.2	204	72.7	28.96	
206	75.7	208	75.2	29.82	
209	78.1	211	77.6	30.67	



Remarks

Notes: See boring log for Boring B-7 for additional details.

Test Results

Pressiometer modulus E:	**1,821 psi**
Ultimate pressure P_L:	**245 psi**
Ratio E / P_L:	7.43
Yield pressure P_F:	139 psi
Ratio P_L / P_F:	1.77

1. Center of probe

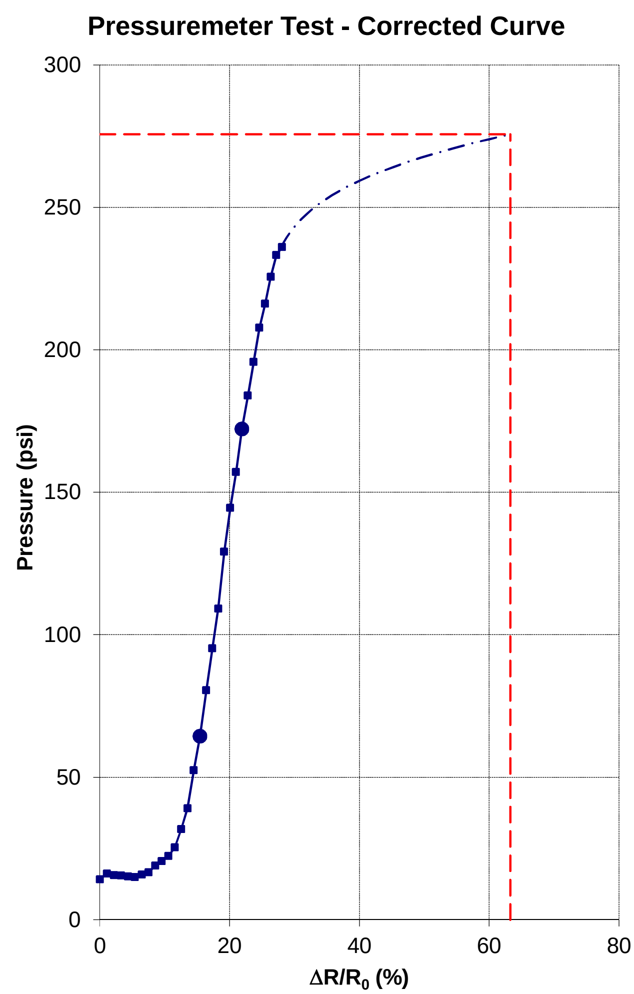
TEXAM COMPANION V.3.3

TEXAM Pressuremeter Test

Terracon

Project name:	W.J.B. Dorn VA Med. Ctr. Parking Gar.	Use of a slotted casing:	No
Borehole name:	B-7	Test depth:	31.00 ft[1]
Test date: (mm/dd/yyyy)	06/03/2015	Manometer height above ground:	1.00 ft
Test number:	Test #3	Poisson's coefficient:	0.33
Probe size:	N	Fluid density:	1.024

Raw Readings		Corrected Readings		
Pressure psi	Volume in³	Pressure psi	Volume in³	$\Delta R/R_0$ %
0	0.0	14	0.0	0.00
3	2.4	16	2.4	1.10
3	4.9	16	4.9	2.20
4	7.3	16	7.3	3.28
4	9.8	15	9.8	4.35
4	12.2	15	12.2	5.41
5	14.6	16	14.6	6.46
7	17.1	17	17.1	7.50
9	19.5	19	19.5	8.53
11	22.0	21	21.9	9.55
13	24.4	22	24.4	10.56
16	26.9	25	26.8	11.56
23	29.3	32	29.2	12.54
30	31.7	39	31.7	13.52
44	34.2	52	34.1	14.48
56	36.6	64	36.5	15.44 ◄
72	39.1	80	38.9	16.38
87	41.5	95	41.3	17.32
101	43.9	109	43.7	18.25
121	46.4	129	46.1	19.17
136	48.8	145	48.5	20.09
149	51.3	157	50.9	21.00
164	53.7	172	53.3	21.90 ◄
176	56.1	184	55.7	22.80
188	58.6	196	58.1	23.69
200	61.0	208	60.5	24.58
208	63.5	216	63.0	25.46
218	65.9	226	65.4	26.33
225	68.3	233	67.8	27.20
228	70.8	236	70.2	28.07



Remarks

Notes: See boring log for Boring B-7 for additional details.

Test Results

Pressiometer modulus E:	**2,634 psi**
Ultimate pressure P_L:	**276 psi**
Ratio E / P_L:	9.56
Yield pressure P_F:	172 psi
Ratio P_L / P_F:	1.60

1. Center of probe

TEXAM COMPANION V.3.3

APPENDIX B
LABORATORY TESTING

Laboratory Testing Description

Samples retrieved during the field exploration were taken to the laboratory for further observation by the project geotechnical engineer and were classified in accordance with the Unified Soil Classification System (USCS) described in Appendix C. At that time, the field descriptions were confirmed or modified as necessary and an applicable laboratory testing program was formulated to determine engineering properties of the subsurface materials.

Laboratory tests were conducted on selected soil samples and the test results are presented in this appendix. The laboratory test results were used for the geotechnical engineering analyses, and the development of foundation and earthwork recommendations. Laboratory tests were performed in general accordance with the applicable ASTM, local or other accepted standards.

Selected soil samples obtained from the site were tested for the following engineering properties:

- Particle-Size Distribution (Gradation) of Soils — ASTM (D6913-04)
- Atterberg Limits Test — ASTM (D4318-10)
- Moisture Content Determination — ASTM (D2216-10)
- Compaction Characteristics of Soil using Standard Effort — ASTM (D698-12)
- Corrosivity Suite
    - pH
    - Water Soluble Sulfates
    - Chlorides

Summary of Laboratory Results

BORING ID	Depth (ft)	USCS Classification and Soil Description	Compressive Strength (tsf)	Liquid Limit	Plastic Limit	Plasticity Index	% <#200 Sieve	% Gravel	% Sand	Water Content (%)	Dry Density (pcf)
B-2	8.5 - 10			46	33	13				22.8	
B-2	18.5 - 20									21.3	
B-2	28.5 - 30						16.2	17.1	66.7	18.2	
B-2	38.5 - 40						14.0	41.3	44.7	21.2	
B-2	48.5 - 50			32	22	10				25.2	
B-2	63.5 - 65									27.5	
B-6	28.5 - 30						12.3	38.2	49.6		
B-6	53.5 - 55			55	25	30				28.4	
B-8	8.5 - 10			42	21	21				17.1	
B-8	28.5 - 30	SILTY SAND(SM)		NP	NP	NP	24.6			24.4	
B-8	33.5 - 35						19.3	3.0	77.7	27.4	
B-8	48.5 - 50			48	24	24				25.8	

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. LAB SUMMARY: USCS 73155038 - VA HOSPITAL BORING LOGS.GPJ LOGS.GPJ 6/26/15

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

SITE: W.B.J. Dorn VA Medical Center
Columbia, South Carolina

Terracon
521 Clemson Road
Columbia, South Carolina

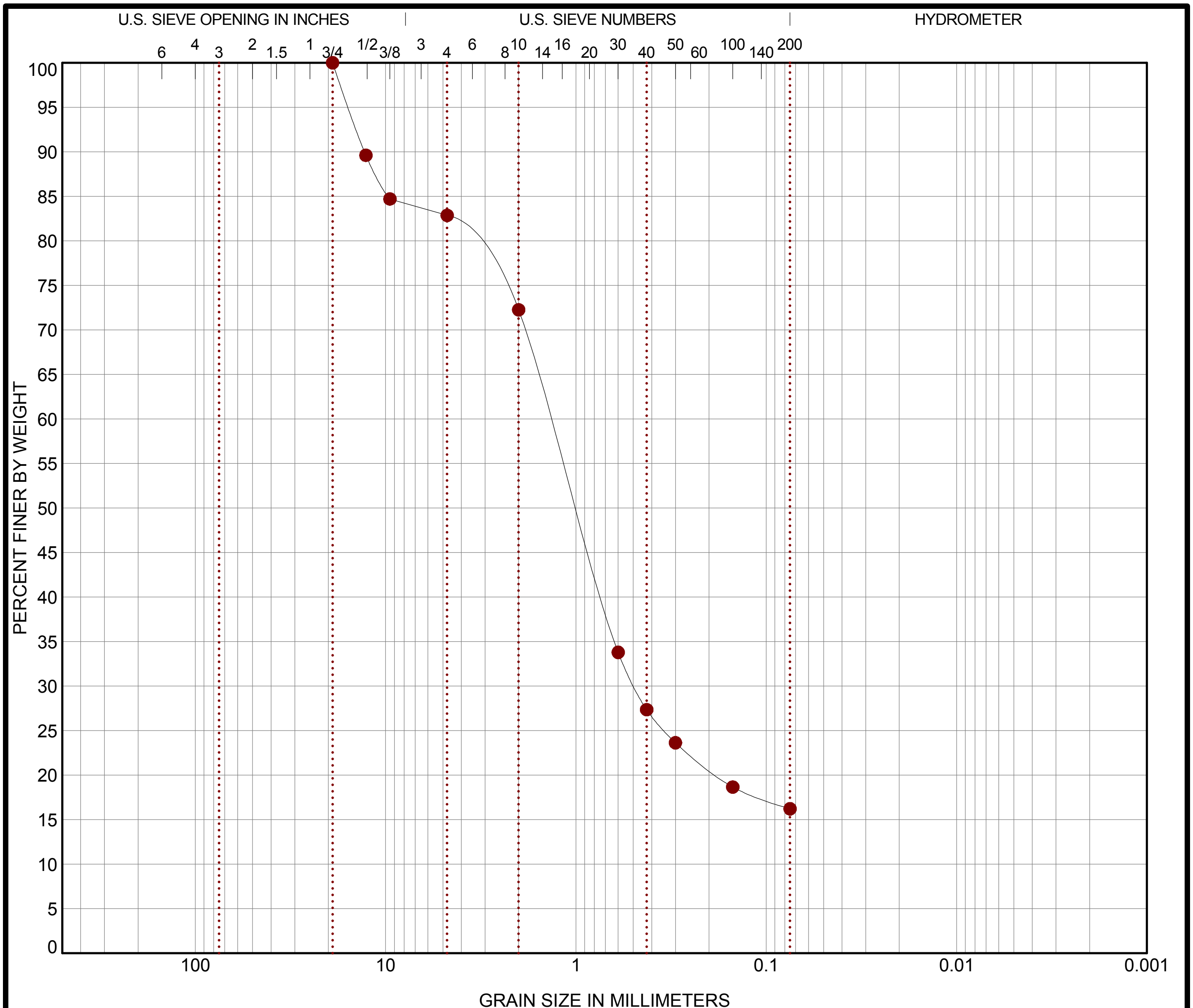
PROJECT NUMBER: 73155038

CLIENT: Guidon Design
Indianapolis, Indiana

EXHIBIT: B-2

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth (ft)	USCS Classification	LL	PL	PI	Cc	Cu
●	B-2	28.5 - 30						

	Boring ID	Depth (ft)	D_{100}	D_{60}	D_{30}	D_{10}	% Gravel	% Sand	% Silt	% Clay
●	B-2	28.5 - 30	19	1.363	0.49		17.1	66.7	16.2	

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

SITE: W.B.J. Dorn VA Medical Center Columbia, South Carolina

Terracon
521 Clemson Road
Columbia, South Carolina

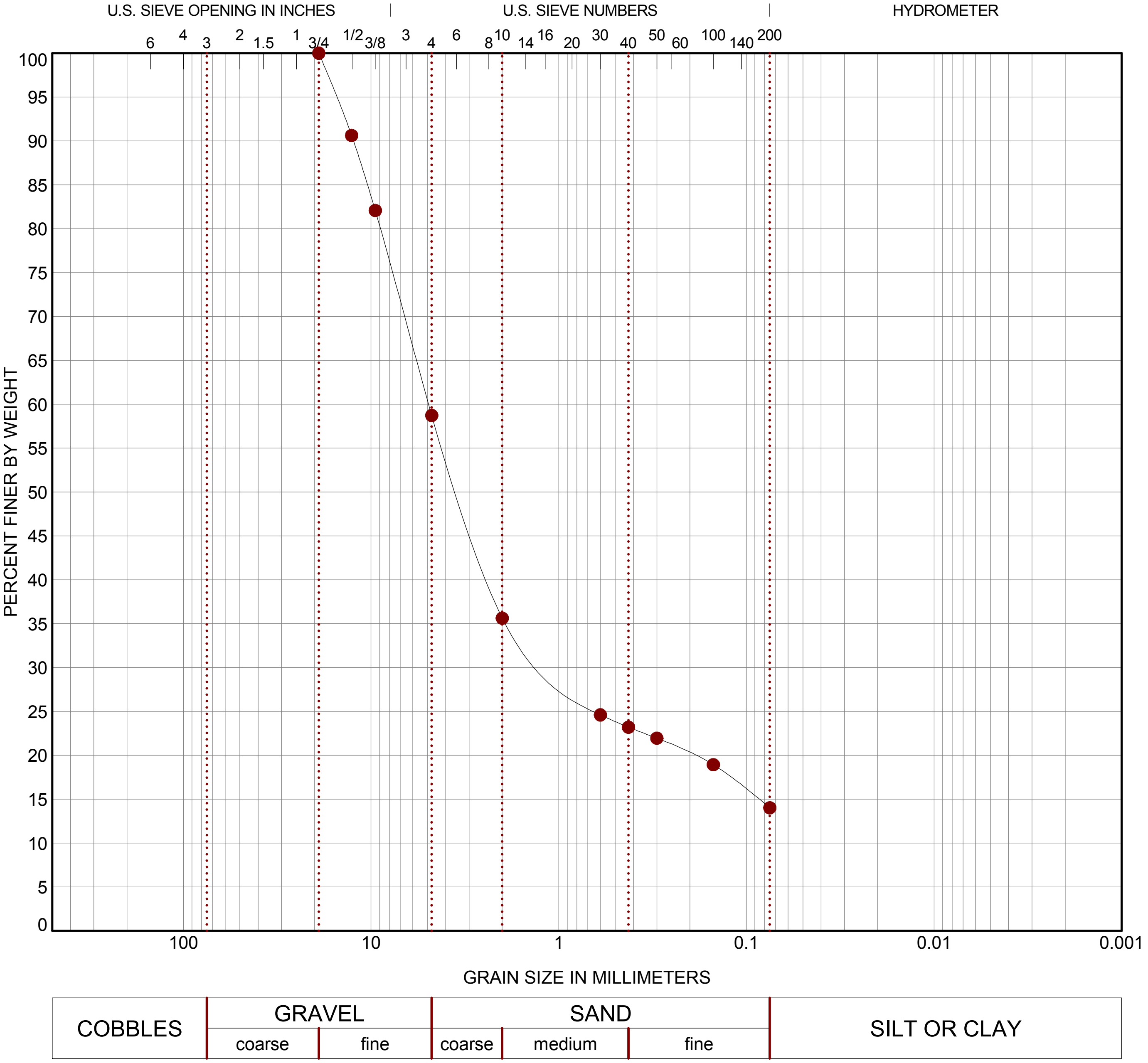
PROJECT NUMBER: 73155038

CLIENT: Guidon Design Indianapolis, Indiana

EXHIBIT: B-3

GRAIN SIZE DISTRIBUTION

ASTM D422



	Boring ID	Depth (ft)	USCS Classification	LL	PL	PI	Cc	Cu
●	B-2	38.5 - 40						

	Boring ID	Depth (ft)	D_{100}	D_{60}	D_{30}	D_{10}	% Gravel	% Sand	% Silt	% Clay
●	B-2	38.5 - 40	19	4.933	1.082		41.3	44.7	14.0	

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage

SITE: W.B.J. Dorn VA Medical Center Columbia, South Carolina

Terracon
521 Clemson Road
Columbia, South Carolina

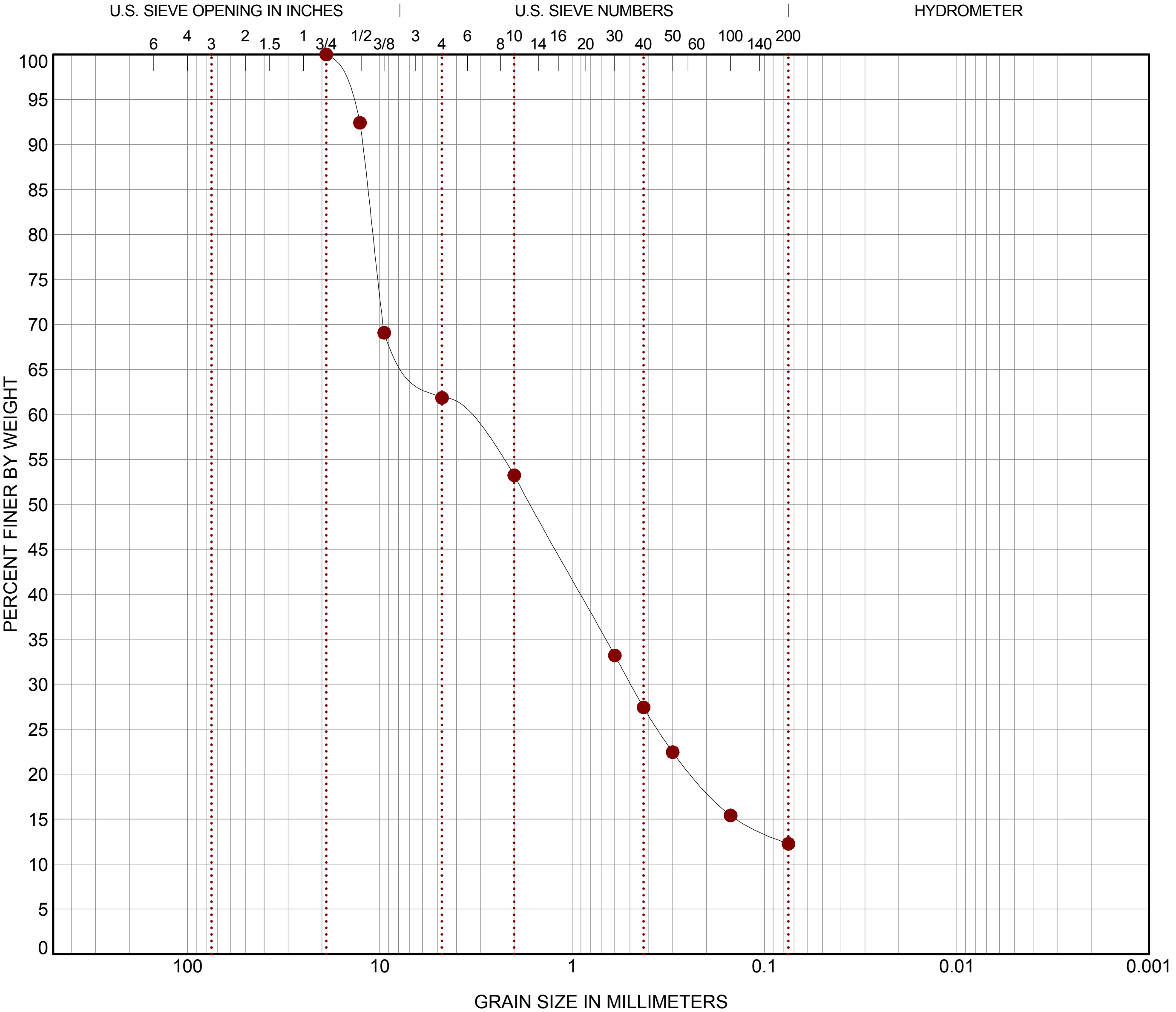
PROJECT NUMBER: 73155038

CLIENT: Guidon Design Indianapolis, Indiana

EXHIBIT: B-4

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth (ft)	USCS Classification	LL	PL	PI	Cc	Cu
●	B-6	28.5 - 30					1.36	86.37

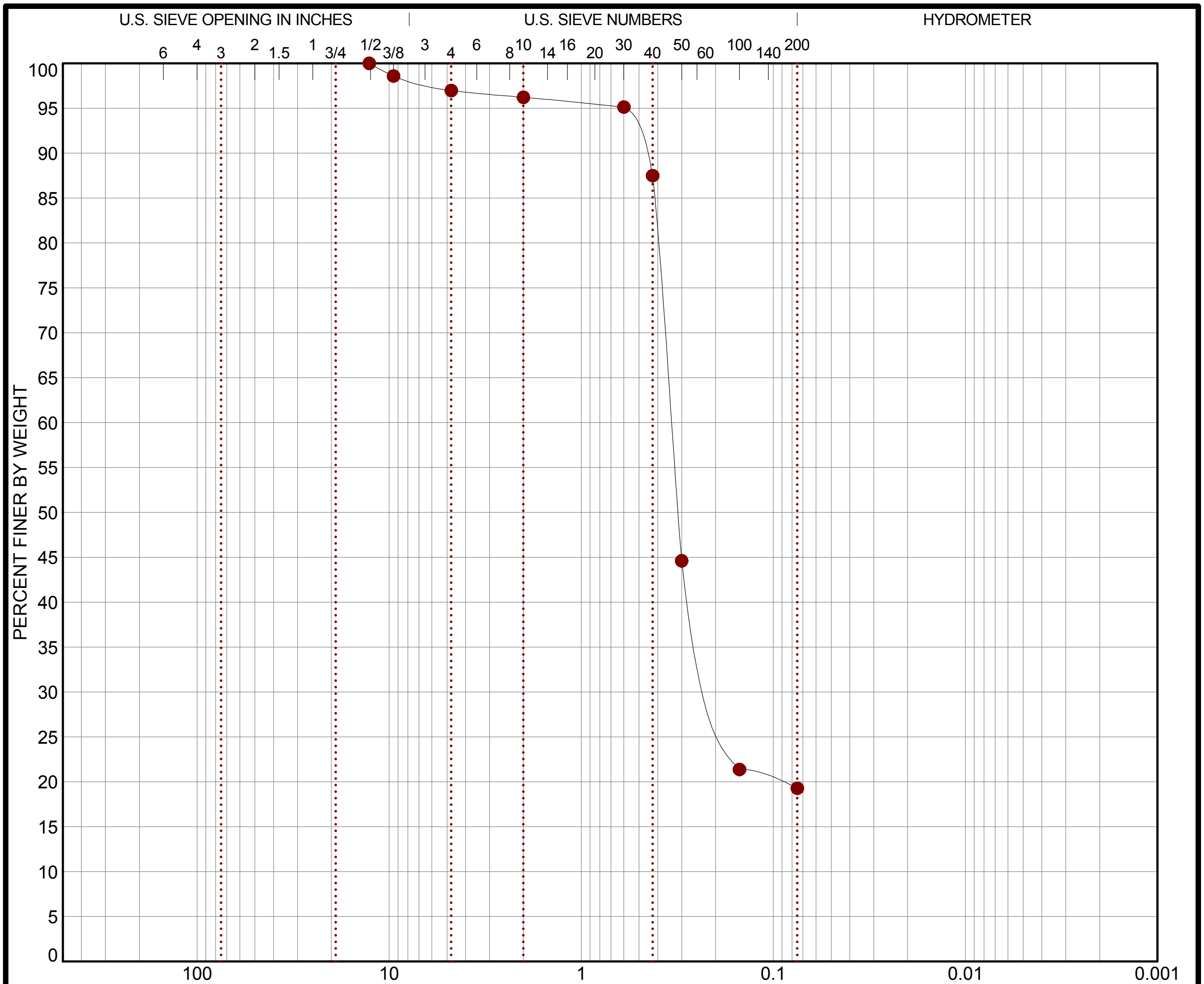
	Boring ID	Depth (ft)	D_{100}	D_{60}	D_{30}	D_{10}	% Gravel	% Sand	% Silt	% Clay
●	B-6	28.5 - 30	19	3.951	0.496		38.2	49.6	12.3	

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS-2 73155038 - VA HOSPITAL BORING LOGS.GPJ LOGS.GPJ 6/26/15

PROJECT: W.J.B. Dorn VA Medical Center Parking Garage	Terracon	PROJECT NUMBER: 73155038
SITE: W.B.J. Dorn VA Medical Center Columbia, South Carolina	521 Clemson Road Columbia, South Carolina	CLIENT: Guidon Design Indianapolis, Indiana
		EXHIBIT: B-5

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring ID	Depth (ft)	USCS Classification	LL	PL	PI	Cc	Cu
●	B-8	33.5 - 35						

	Boring ID	Depth (ft)	D_{100}	D_{60}	D_{30}	D_{10}	% Gravel	% Sand	% Silt	% Clay
●	B-8	33.5 - 35	12.7	0.34	0.194		3.0	77.7	19.3	

PROJECT: W.J.B. Dorn VA Medical Center
Parking Garage

SITE: W.B.J. Dorn VA Medical Center
Columbia, South Carolina

Terracon
521 Clemson Road
Columbia, South Carolina

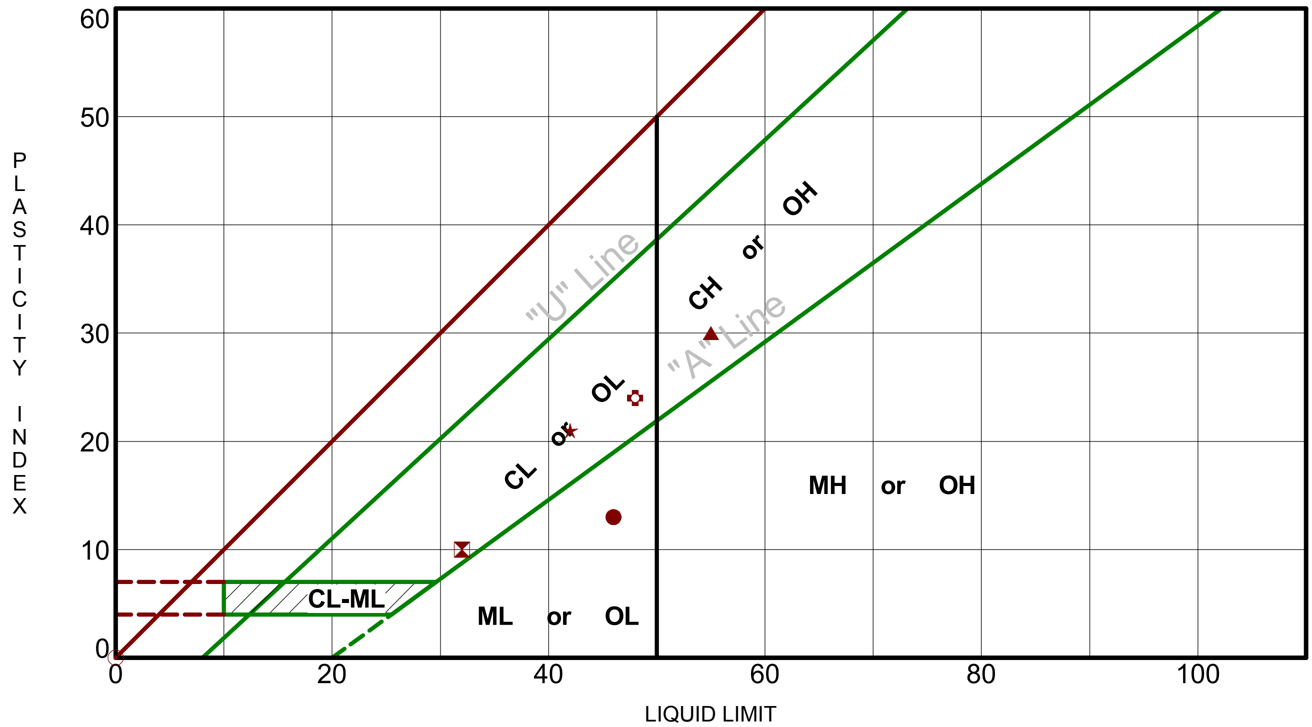
PROJECT NUMBER: 73155038

CLIENT: Guidon Design
Indianapolis, Indiana

EXHIBIT: B-6

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	B-2	8.5 - 10	46	33	13			
⧗	B-2	48.5 - 50	32	22	10			
▲	B-6	53.5 - 55	55	25	30			
★	B-8	8.5 - 10	42	21	21			
⊙	B-8	28.5 - 30	NP	NP	NP	25	SM	SILTY SAND
✪	B-8	48.5 - 50	48	24	24			

PROJECT: W.J.B. Dorn VA Medical Center
Parking Garage

SITE: W.B.J. Dorn VA Medical Center
Columbia, South Carolina

Terracon
521 Clemson Road
Columbia, South Carolina

PROJECT NUMBER: 73155038

CLIENT: Guidon Design
Indianapolis, Indiana

EXHIBIT: B-7

CHEMICAL LABORATORY TEST REPORT

Project Number: 73155038
Service Date: 06/15/15
Report Date: 06/16/15
Task:

Terracon
750 Pilot Road, Suite F
Las Vegas, Nevada 89119
(702) 597-9393

Client

Guidon Design

Project

W.J.B Dorn VA Medical Center Parking Garage

Sample Submitted By: Terracon (73) **Date Received:** 6/11/2015 Lab No.: 15-0408

Results of Corrosivity Analysis

Sample Number		
Sample Location	B-1	B-6
Sample Depth (ft.)	6.0-7.5	38.5-40.0
pH Analysis, ASTM G 51	7.66	8.07
Water Soluble Sulfate (SO4), ASTM C 1580 (Percent, %)	<0.01	<0.01
Chlorides, ASTM D 512, (Percent, %)	<0.01	<0.01
Sulfides, AWWA 4500-S D, (ppm)	Nil	Nil

Analyzed By: Kurt D. Ergun

Kurt D. Ergun
Chemist

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger	Split Spoon
Shelby Tube	Macro Core
Ring Sampler	Rock Core
Grab Sample	No Recovery

WATER LEVEL

- Water Initially Encountered
- Water Level After a Specified Period of Time
- Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

Terracon

Exhibit C-1

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve
[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.
[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10} \qquad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.
[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.
[H] If fines are organic, add "with organic fines" to group name.
[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.
[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.
[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.
[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.
[N] PI ≥ 4 and plots on or above "A" line.
[O] PI < 4 or plots below "A" line.
[P] PI plots on or above "A" line.
[Q] PI plots below "A" line.